THE ELECTRICAL WORLD

A Weekly Review of Current Progress in Electricity and its Practical Applications

VOL. I.—No. 26. NEW YORK, JUNE 30, 1883. $2 A YEAR. 5 CENTS PER COPY.

Electrical Street Cars.

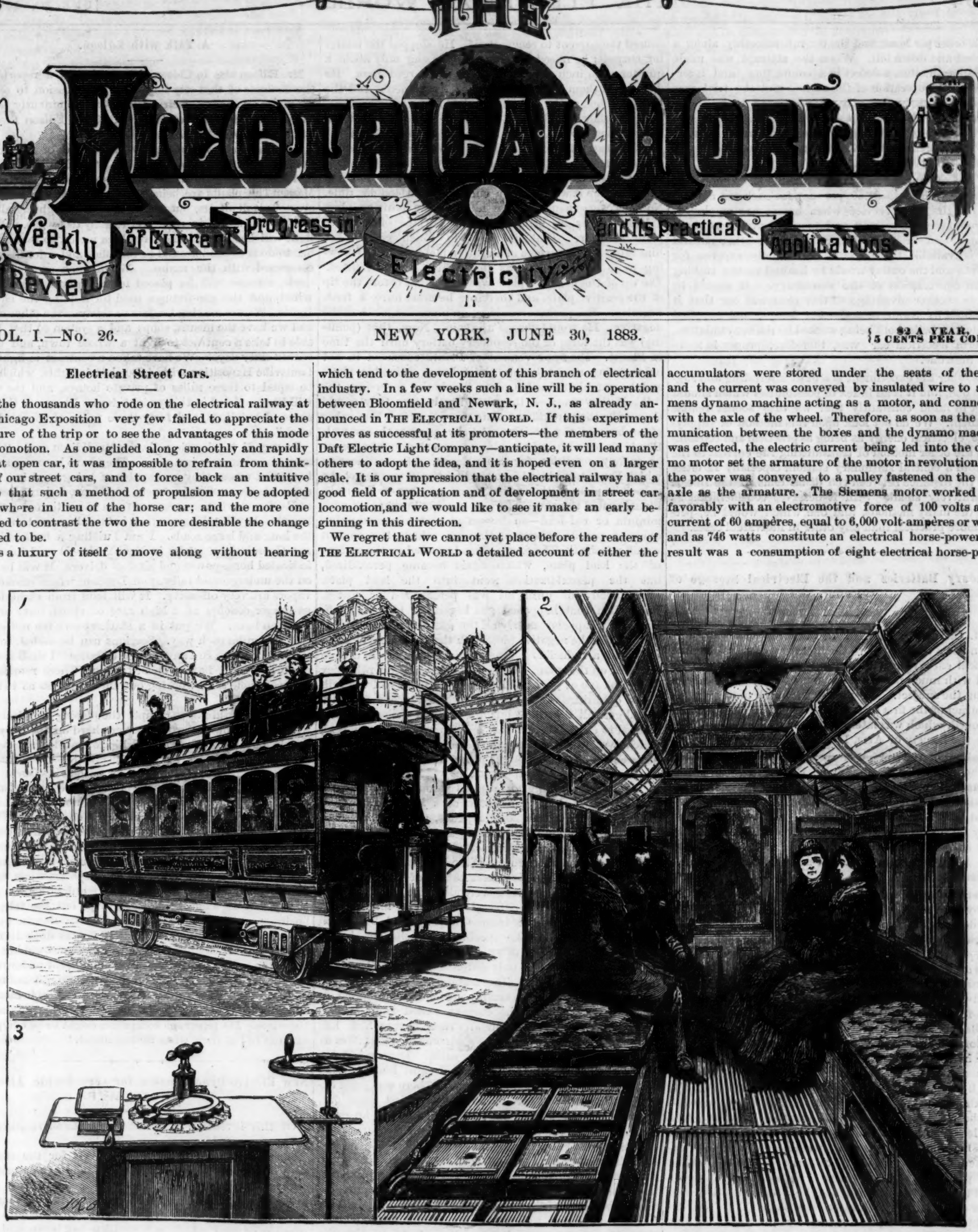
Of the thousands who rode on the electrical railway at the Chicago Exposition very few failed to appreciate the pleasure of the trip or to see the advantages of this mode of locomotion. As one glided along smoothly and rapidly in that open car, it was impossible to refrain from thinking of our street cars, and to force back an intuitive desire that such a method of propulsion may be adopted everywhere in lieu of the horse car; and the more one stopped to contrast the two the more desirable the change seemed to be.

It is a luxury of itself to move along without hearing the cadence of clattering hoofs as they move over the paving stones, not to speak of the relief experienced in the thought that the driver is not plying his whip at the same time that he wields his vocabulary with that earnestness that makes one think the energy used in the propulsion of the car is stored in him. The cable system of propelling street cars, which is also to be seen in Chicago, is itself a great improvement on the older system, and, in fact, reminds one of the electric railway. But it does not appear so universally and generally applicable as the electrical street car, while it has some disadvantages, from which the electrical street car is free.

The comparative economy of the two it is hard to determine, but certainly if the limited experience which electrical engineers have had with the electric railway is a criterion, the electrical street car is bound to be the more economical of the two. Although there is no electrical street car yet in operation in America, there are several projects afoot which tend to the development of this branch of electrical industry. In a few weeks such a line will be in operation between Bloomfield and Newark, N. J., as already announced in THE ELECTRICAL WORLD. If this experiment proves as successful at its promoters—the members of the Daft Electric Light Company—anticipate, it will lead many others to adopt the idea, and it is hoped even on a larger scale. It is our impression that the electrical railway has a good field of application and of development in street car locomotion, and we would like to see it make an early beginning in this direction.

We regret that we cannot yet place before the readers of THE ELECTRICAL WORLD a detailed account of either the Chicago electric locomotive or the Daft electrical car, but we take occasion to give some details about an experiment in street car locomotion by electricity, which was made at Kew Bridge on the Acton tramway line, London, a few weeks ago. This experiment is interesting from the fact that the car carried its own supply of electrical energy in storage batteries, instead of receiving it from a stationary generator by being conveyed along the rails or other suitable conductors, as has been done in all other cases. The car used at the Kew Bridge experiments and shown in the accompanying illustration was fitted with an accumulator battery consisting of 50 Faure-Sellon-Volckmar cells, each measuring 18 in. by 11 in. by 7 in., and weighing about 80 lbs. The accumulator battery was capable of working a tramcar with its full load for half a day, or in other words seven hours. When charged it contained about 560 ampère-hours, of which 400 were withdrawn with the greatest regard to economy. The accumulators were stored under the seats of the car, and the current was conveyed by insulated wire to a Siemens dynamo machine acting as a motor, and connected with the axle of the wheel. Therefore, as soon as the communication between the boxes and the dynamo machine was effected, the electric current being led into the dynamo motor set the armature of the motor in revolution, and the power was conveyed to a pulley fastened on the same axle as the armature. The Siemens motor worked most favorably with an electromotive force of 100 volts and a current of 60 ampères, equal to 6,000 volt-ampères or watts, and as 746 watts constitute an electrical horse-power, the result was a consumption of eight electrical horse-power and a yield on the pulley of five and three-fifths electrical horse-power. The action of the motor could be reversed at will, and the power increased or diminished as required by adding to or taking from the number of cells composing the accumulator by means of a simple switch (3), and by breaking the circuit the motive power was stopped, and the brake being then applied the car was almost immediately brought to a standstill. The cost of horse-power produced from a stationary engine of large size has been ascertained, and is universally accepted as one halfpenny per horse-power hour. Five hundred steam horse-power would, therefore, cost 250 pence, equal to £1 0s. 10d. per hour. This power would be applied to the working of dynamo-electric or generating machines.

At the trial trip several noted electricians were present, and the experiment was pronounced by them fairly satisfactory. The car could carry a load of forty-six persons, the total weight being about five tons. The speed attained



NEW ELECTRIC STREET CAR AT KEW BRIDGE, LONDON.

1. The Car. 2. Interior of Car, with one cushion removed, showing the Accumulators. 3. Starting and Reversing Handles.

was six miles per hour, and the car ran smoothly along a level road and down hill. When the attempt was made to ascend an incline, a defect in a connecting band interfered with the operation of the motor, and the trial was interrupted at that point. There is believed to be, however, no serious difficulty involved in the case, and it was decided to place electrical cars on the Acton road as soon as the necessary license could be obtained from the Metropolitan Board of Works.

The cost of running cars in this manner is estimated at a sum equivalent to $1.50 per day for each car, against $6.25 for the same service when horses are employed. This would seem to promise an important saving to those interested, and in places where water or other natural power is available there would be no daily expense for fuel, etc., and the outlay would be limited to the sinking fund for depreciation of the machinery. It should be stated as another advantage of this electrical car that it was lighted by Swan incandescent lamps, and supplied with electric bells, both being worked by the accumulators. The term electrical car was, therefore, proper in more senses than one.

Altogether the experiment is a most interesting and suggestive one, and it is an index of possibilities which should be kept in mind constantly that we may sooner realize from them. We do not look upon this method of supplying the electrical energy as being as practical and economical as the other method of transmitting the current to the cars from a central stationary station, especially in cities where the distance between the distal ends of the line is comparatively small. Still it deserves consideration as one of the many methods, and one which would be, perhaps, more practical than any other in individual cases.

Secondary Batteries and the Electrical Storage of Power.

Prof. Oliver J. Lodge, M. A., D. Sc., is well known in England as a contributor to the literature of the storage of electrical energy and his writings have always been received with much favor, on account of their originality in treating the subject. We present herewith to our readers an abstract of the first of two lectures on the subject above mentioned, which was lately delivered by Professor Lodge before the Society of Arts, London.

Speaking of the storage of energy, Professor Lodge said that the methods were numerous. Energy might be stored mechanically or chemically, and though he accepted the definition "electrical methods of storing energy," he considered that as a matter of fact all methods of storing energy by means of electrical agency could be classified either as mechanical or as chemical; at any rate, they could be resolved into electro-mechanical or electro-chemical.

After giving several illustrations of the storage of energy by both mechanical and chemical processes, the lecturer described the general principles of secondary batteries, and in regard to the plates said that what they wanted was a plate to hold the oxygen and become oxidized. Lead forms an insoluble oxide and was consequently suitable for the purpose. A few others were insoluble, but lead had the advantage. It was better than either silver or manganese, for the reason that its oxide was less soluble. They had the plate gradually eaten into by the oxygen. Hence the storage of a large quantity of energy. What became of the hydrogen? Did the lead plate absorb the hydrogen? He thought it did to some extent, and that the lead became hydrogenized. Dr. Frankland said it did not. Dr. Frankland was most likely right, but on the hypothesis that the lead absorbed no hydrogen and that the lead was lead, pure and simple, he could not understand how he obtained certain results by certain experiments. He must there say a word about the positive and negative plates. Some people called the one plate positive and the other negative, and others *vice versa*. The matter was simple. If one decided to call that the positive plate by which the current entered and from which the discharged current left, they ought not to call it sometimes the positive and sometimes the negative—the positive when charged and the negative when discharged—that leads one into intolerable confusion. Supposing (experimenting with a small cell) he took away the negative or hydrogen plate and replaced it by a bit of clean lead, according to Dr. Frankland the negative plate did not differ from clean lead—it absorbed no hydrogen—it was nearly exhausted; it gave a current for only a second or two. To prove that it was not the positive plate which was exhausted, he should remove the clean lead and put in an old piece of lead which had not replenished itself. It showed more strength, and so he thought the plate in that respect must differ from ordinary lead, and how it differed he could not understand, except in consequence of the hydrogen. When the cell itself ran down, which, he would ask, was the first to fail? Did the negative plate fail first and become exhausted of its hydrogen, or did the positive plate become deoxidized, or did they both fail together? He tried that experiment by immersing the plates a little bit in the liquid and letting that little bit exhaust itself, and then introducing a little more of the plates and seeing which caused the current to renew itself. He stopped the charging current; he raised the plates, immersing only about a quarter of an inch of each, and then discharged them. He discharged them by putting on the galvanometer and the bell (attached to the cell with which he was experimenting), and they would hear that the bell and see that the galvanometer were weak. Now, that (pointing to the positive plate) was exhausted. If he let it stand it would recover itself a little; if they let it stand a short time it would give a current for a short time; if they let it stand a longer time it would give a current for a longer time. Now, having exhausted it, let him dip the positive plate a little deeper in, bringing a new surface of positive plate to bear. That did not do much good. Let him bring a new surface of negative plate to bear (showing more energy). It was that which was exhausted. The tip of the negative plate was exhausted before the tip of the positive plate, and therefore he must have a fresh negative. The positive would go on much longer than the negative. He would charge up again. Now, that (pointing) was the form of the secondary battery until the time of Planté. The improvement of Planté consisted in not only giving an oxidizable plate, but a reducible plate, and he got his reducible plate simply by reversing the cell. If they reversed the charging battery they would then make the peroxidized plate the negative. The other plate became the positive. So by perpetual reversals Planté managed to get the plates into a thoroughly porous or spongy condition for some depth. The modification which Faure introduced into the Planté cell was to get the reducible plate without that great number of reversals. Planté coated the plate before proceeding to charge it with minium or red lead—an imperfect and non-conducting oxide—a porous substance through which the current would penetrate. The oxygen was liberated on the surface of the lead plate, which again became peroxidized, but the peroxidization went into the lead plate, and spread out until all was peroxidized or coated, and when that happened gas began to be given off. Until that happened nearly all the gas was absorbed. If they coated the negative plate with the same kind of stuff, they had a reducible plate practically. The hydrogen liberated on the plate did not escape, consequently they had no escape of gas on either plate until the cell was full. If the quantities were properly adjusted the two plates would get full together; but the oxygen generally commenced to escape before the hydrogen. In the process, which was quicker than the Planté process of forming a Faure cell no reversals of currents, as he had said, were used. The operation took a week, or perhaps not so long; the Planté operations took two or three months. In making the Faure cells it was not found easy to keep the coatings on the plates, and the plates had to be wrapped up in felt or cloth. The next improvement consisted in not using coatings at all so much as putting the substance which formed the coatings into interstices in the lead. This was a patent of Mr. Swan and Mr. Sellon. The plates now were all made with perforations, and the substance adhered to them very much better. The Electrical Power Storage Company had been good enough to lend him the specimens of cells, etc., before them. The plates were of two sizes. They were packed together in boxes. The only difference in the cells was in the number of plates. The amount of electricity that could be stored up in the small plates might be stated at 16 ampère-hours, and the current varied from two to three ampère-hours; consequently those boxes which had nine pairs of plates would take a current of about 20 or 30 ampères, and give out about the same. They would discharge at that rate between six and eight hours, giving out a quantity of about 160 ampères. There was great excitement about the Faure battery when it first came out, and public attention was directed to it to rather an exaggerated extent. Recently the interest in it abated, and very little was known as to what was being done. He had in his laboratory at Liverpool 25 of these cells. He found them most invaluable, and was surprised at the perfection produced in them during the last year. The difference between putting the coating on the plate and into the interstices struck him as a very small improvement, but if they put it to the test of practice it seemed to be an improvement. The chemical process which went on in discharging the plates was very much the reverse of that which went on in charging. If the cells were kept in full action, they were preserved in a remarkably perfect state of efficiency, but if they allowed them to stand idle and electrically empty the negative plates rapidly sulphated themselves up, and the composition lost its adherence and was apt to tumble out. Many of the defects to be found in cells were due to this ill-treatment. If they kept the battery in action it behaved exceedingly well. The only way to get rid of the sulphate was to apply a small charging current for a long time—a week or a fortnight—and start afresh. The sulphate of lead on the positive plate did not matter so much. The electromotive force of a cell was about two volts. They must never keep the cells full or drain them. They thus got a good return for the energy they put in. The lecturer concluded by briefly referring to meters. Ayrton and Perry's meter, he said, was a remarkable instrument; it was a somewhat striking example of the improvements introduced into pure science by the acquirements of technical science.

A Talk with Edison.

Mr. Edison was in Chicago last week, and a reporter of the *Tribune* of that city improved the occasion to obtain his views on sundry electrical matters prominently before the public. Speaking of the work of the Edison Electric Light Company, Mr. Edison said:

"We have closed contracts with the cities of Shamokin, Sunbury, Danville, Williamsport, and Erie. Pa.; Utica and Lockport, N. Y.; Brocton, Lowell, and Lawrence, Mass. The plants are being placed in those cities. They are not small affairs, but plants capable of lighting all the houses and stores in each city exactly as by gas, and the light will be sold and measured by a meter, so that all one has to do is to send around to the office and order his place connected with the mains. When such connection is made, a meter will be placed in the premises, the house wired, and the gas-fixtures used for holding the electric lights. We are making tenders to thirty-seven other cities, and we have the means, shops and a system so that I am able to take a contract to light a whole town, and do so within sixty days. We have taken a contract to light the Louisville Exposition with 4,800 electric lights, which will be equal to three miles of private houses, and the work will be completed in thirty-eight days. There are thirteen acres of buildings, and forty-three miles of wires will be used."

In regard to electric railways Mr. Edison says: "They are somewhat new just now. They have been worked up to a point where they are capable of being used in a great many places, such as in streets, on the ground and elevated roads, for short distances, say from three to four miles in length. It will take some time before they can be used on the long and large roads. I am building a locomotive at my Goerck street works in New York. It will have 375 indicated horse-power and six-foot drivers. It will be used on the underground railway in London, where smoke and vapors are very offensive. It will haul from eight to ten passenger coaches at a high rate of speed, forty or fifty miles an hour. We put in a station every ten miles, and feed five miles each way. Sections can be added, so that the trains can be run any desired distance. I shall make it perform what I have promised to do. There remains no other obstacle than working out the details so as to make it practicable."

Mr. Edison thinks to compel the placing of all electric wires underground "would be very hard on the telephone people, but not much of a hardship to the telegraph people. As far as electric wires are concerned, we want to put them underground if they will let us do so. Our system is adapted to laying the wires beneath the surface of the earth. We have twenty-three miles of underground wires in New York City now. In all large cities electric wires ought to go underground. With telephone wires it is different, owing to the induction, which makes it difficult to talk over wires so laid. There has been no means thus far found out to stop the induction on telephone wires, except by using a metallic circuit, which requires such a large outlay that it would practically wipe out the telephone business. I think there would be no trouble in putting telegraph wires underground. If it was done it might cut off some of Gould's dividends, but that wouldn't matter to the public. There are a dozen different underground telegraph systems. In London there are 300 miles of underground wires. They work well. They are each insulated and run inside of iron pipes, some of which contain over 100 wires. The telegraph companies ought to be compelled in cities to put their wires underground."

New Electro-Dynamometer for very Feeble Alternating Currents.

Of this invention M. Bellati in *La Lumière Electrique* says:

This instrument, designed exclusively for the study of very feeble alternating currents, depends upon a principle which, to my knowledge, has not yet been utilized in its greatest simplicity. Let us suppose that the magnetic needle of a reflecting galvanometer is replaced by a small iron bar or wire, which can oscillate in a horizontal plane and which, in its position of equilibrium, will be perpendicular to the magnetic meridian.

Under these conditions the iron bar is not influenced by terrestrial magnetism and, if well-annealed and of good quality, it presents no trace of magnetic polarity. If we suppose now that the plane of the galvanometer coil forms an angle of about 45 degrees with the magnetic meridian, and that a current circulates in the coil in either direction, the iron bar is temporarily magnetized and tends to take a direction perpendicular to the plane of the coil. Consequently, though the currents may alternate, the deviation of the bar is always in the same way.

The simplicity of this apparatus consists in the suppression of the movable solenoid of the ordinary electro-dynamometer, and in the complicated system of suspension accompanying it. The movable solenoid is here replaced by the iron bar whose office is the same; it can be suspended by a thread of feeble torsion, or better, by a double cocoon thread, according to the bifilar system. The extreme lightness of the movable part renders the instrument very quick and sensitive.

It may be thought that the alternate magnetizations of

the iron wire would not obey the reversed currents with sufficient rapidity. But the phenomena of the telephone seem to show that, with *weak* current, iron obeys the magnetizing actions almost spontaneously. If that be admitted and also that, for weak currents, the induced magnetism is proportional to the current's intensity, the theory of the instrument is quite simple. It only remains to examine its degree of sensitiveness.

To this end I have constructed an apparatus which although quite rough has enabled me to make several experiments. Instead of an iron bar I employed a bundle of iron wires carefully annealed. These were 17 millimetres long and 0.15 mm. in diameter. A very small light mirror was fixed to the bundle and the system was suspended bifilarly by cocoon thread.

The interior diameter of the coil was 35 mm. and the length was 38 mm. The copper wire of about 0.2 mm. diameter had a resistance of 167 Siemens units (159.25 ohms) and formed a layer of about 8 mm. in thickness. The glass and scale for reading were placed 2 metres from the instrument. In my experiments I used a Siemens telephone whose resistance was 185 Siemens' units (176.416 ohms).

The conditions of the instrument were not the best, especially in regard to the solenoid, yet the results were quite satisfactory. When a trumpet connected to the Siemens telephone was blown into, the deviation of the iron bundle was too large to be read. By applying the telephone to the mouth and speaking quite low an appreciable deviation was observed. A deviation was again obtained by shouting before the telephone at a distance of 50 centimetres and also while holding the trumpet 25 centimetres away from the mouth of the telephone and blowing into it so as to produce the feeblest possible sound.

These results, obtained by such a rough instrument, lead me to hope that under better conditions and with the use of some devices readily contrived, an electro-dynamometer of extreme sensibility can be constructed. This instrument would facilitate the study of low alternating currents and would also replace with advantage the telephone in the so-called "zero methods," in which the employment of the telephone is frequently very difficult.

Mr. Edison's Opinion of Electricity as a Motor.

Mr. Edison was questioned recently as to the feasibility of running trains by electricity on the regular railroads.

"The manner in which it is proposed to operate the railroads by electricity," he said, "is by means of a central rail laid between the existing tracks, for which old and worn-out rails might be used, this rail acting as one pole and the other two forming the other. The power would be transmitted by a central engine with the use of powerful dynamos, and the electricity would thus be supplied to the rail, from which it would be taken up by the motor attached to a train where there are two or more cars attached. In the case of street surface the motor could be carried underneath, and would not necessitate an extra carriage for a motor engine. The whole operation would be similar to the endless rope by which cars are drawn along in Chicago and other cities. The method of stopping would be by means of a 'clutch,' whereby the electric power would be thrown out of gear so far as it operates on the drawing or driving power of the motor, while at the same time the current would still be kept operating on the motor so that a start could be effected at a minimum loss of power, similar to the shifting of a belt on a shafting."

The advantages he claims for the new invention is that it will effect a saving of 33 per cent. in the amount paid for coal under the present system of steam locomotives. There would also be a slight saving in the matter of the wear and tear of the two different styles of engines or motors.

"For the present," continued Mr. Edison, "I do not think that electricity will be generally adopted for heavy freight trains or for passenger trains over long distances, but for street cars, elevated railroads and other short lines it will be found invaluable. Already we have applications for the use of our patents from Coney Island, Long Branch, Fairmount Park, Saratoga, and from the elevated railroads in New York. In the case of the latter it will effect not only a saving of 33 per cent. in the matter of coals, but it will also do away with one man on each engine, and further save the annoyance now experienced in the matter of the shower of sparks and the smell of sulphur which is so objectionable."

The exact form the motor attached to a train would take he could not, he said, at present give, but he believed it would take one of the shapes of Mr. Field's patents. The matter of snow would be no impediment to the transmission of power, as a sort of a cow-catcher had been devised that would so come in contact with the central rail through which it would be transmitted that it would at all times and in the severest storm be entirely cleared off. Any rate of speed could be obtained, according to the power used at the central depots.

When asked if he thought steam as a motive power would be eventually superseded by electricity, Mr. Edison said that he had no doubt such would be the case, but not for some years to come. Steam, he said, is now and will be essential to the generation of electricity, but he believed that means sooner or later will be found to obtain electricity from the earth without the use of any machinery whatever.

Electric Lighting.—XXIX.

Among the objections to the Jablochkoff candle, the most serious is the fact that it will not relight itself when, from any cause, it has been extinguished. As long as the current is maintained steady and free from fluctuations, the candle continues to burn without interruption. If, however, the belts happen to slip and thus allow a momentary fall of current, or if the circuit is opened at any point, or a short circuit occurs—in fact, if anything occurs to reduce the amount of current supplied the lamps—then the arc is liable to break at one or more of the candles on the circuit. After it is broken at one point all the candles on that circuit will necessarily go out, and then it is impossible to pass any current, since there is a break at every candle. In order to light the candles again it is necessary to place a small strip of carbon, or any conducting substance, across the tip of each candle to close the circuit and permit the current to pass. The most expedient thing to do, under the circumstances, is to turn the commutating switch at each lamp, and thus bring a new candle in circuit. This might not be very inconvenient if the interruption involves only a few lights; but when there are several of the circuits of the distributer involved, and when the whole installation is deranged, as would likely happen if the belt slipped, the annoyance would be very great, and as it would take some time to go to each lamp to turn the switch, many of them would remain in the dark during a long interval. The interruption may take

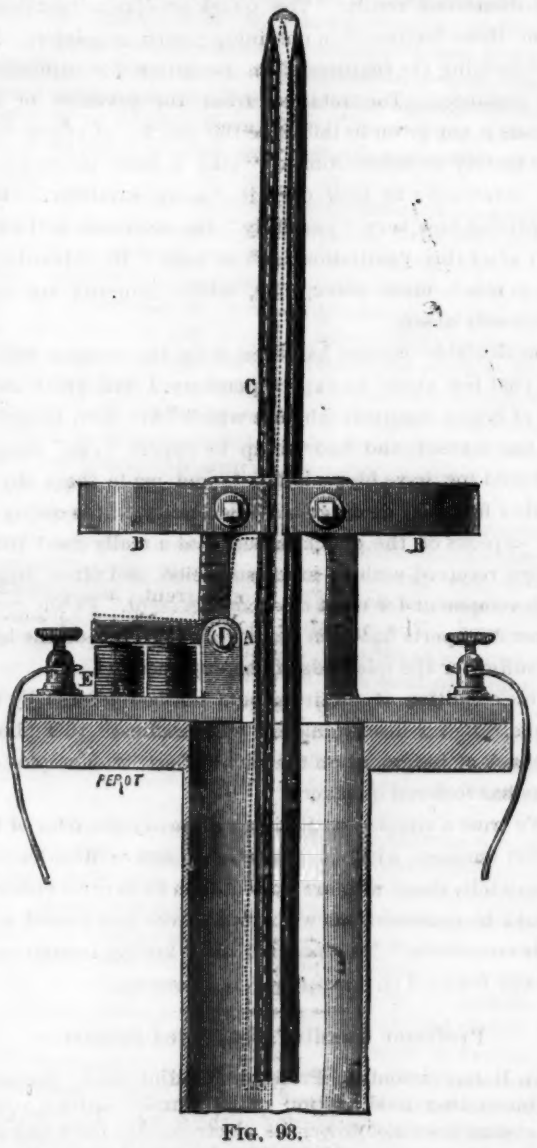


FIG. 93.

place when the candles have scarcely been burned any, and still the remainder of them will be wasted, which would not be the case if there were automatic means of re-establishing the circuit after it has been interrupted.

With the ordinary arc regulators such interruptions of the current do not produce very serious results, because, as soon as the current stops the carbons come together and the circuit is closed and ready to receive the current. In the majority of cases the sudden interruption of the arc at one lamp is scarcely noticeable at the other.

It was this great disadvantage of the Jablochkoff candle, together with the unpleasant play of colors which the incandescence of the "colombin" produces, that led other inventors to attempt improvements in the construction of electric candles. Among the first was Mr. Henry Wilde, of England, whose name has already been identified with the development of the dynamo-electric machine. The candle of Mr. Wilde (Fig. 93), produced in 1878, differs from the Jablochkoff in having no colombin, and in the fact that the carbons touch each other at their tips when no current is passing. The carbon pencils are made of about the same diameter as the Jablochkoff candle, that is to say, four millimeters. Each pencil is held between two jaws, which are made to pass against it by a hoop shaped spring *B*, embracing both. The pair of jaws corresponding to the right-hand carbon in the figure are supported on a vertical arm fastened to the base of the lamp, and are in connection with one pole of the lamp. The arm which carries the jaws, holding the other carbon *C*, oscillates on a pivot *A*, precisely like a bell crank lever. From this arm the circuit leads to the electro-magnet *E* and thence to the binding post. When no current is passing the weight of the carbon *C* causes the bell crank lever to move, and its carbon *C* to tilt until the two carbons touch at their upper ends, this inclined position of the carbon *C* being represented in the figure by the dotted lines. As soon as the current is put on the electro-magnet *E* attracts the horizontal portion of the bell crank lever, which forms its armature, and the carbon *C* is moved away from contact with the other carbon and the arc established between the points. The carbons then burn down as in the Jablochkoff candles, and are consumed at the rate of about twelve centimeters per hour. By making the support of the candle hollow, Mr. Wilde is enabled to use much longer carbons. In some instances they are as much as sixty-five centimeters long, and are both slipped upward at intervals through the jaws holding them. In this way they may be made to last four or five hours without needing any renewal of carbons. When the number of hours of lighting is greater than five, a number of candles are grouped into the same lamp, just as in the Jablochkoff system.

THE WESTON TORCH.

A modification of the Wilde candle which has appeared in this country deserves mention in this connection. It is the invention of Mr. E. Weston, of electric light fame. Its arrangement of parts is essentially the same as in the Wilde candle. A magnet acting on an armature causes the carbons to separate under the influence of the current, and the movable carbon inclines to or from the other in the same manner as in the Wilde candle.

The arrangement was intended to be operated with continuous currents, consequently the stationary carbon was made twice as large. This carbon was also grooved longitudinally to receive a stick of glass, lime, or other refractory substance, intended to serve the same object as the "colombin." To this form of candle Mr. Weston gave the name of "torch." It does not appear to have been used at all in practical electric lighting.

The Electric Wonders of the Age.

Hon. S. S. Cox, in the annual address delivered before the Indiana Asbury University at Greencastle, on the 19th, said:

"The electric monograph transmits messages in the original handwriting. The hektograph multiplies your epistles; the telephone enables people to make contracts through an orifice; but as there is no witness, photography comes in and records the shadow of the sound by curves in vowels and consonants!

"Electricity is an element elusive and subtle, yet it is stored in a box and imprisoned in a metal to be used at pleasure, for portraiture, sound, light or power. I have seen an organ in Berlin played by electricity, but this is simple compared with other experiments. Is it not a marvel that we can telegraph from a moving railroad car or the speeding steamship? A California photographer obtains six photographs in one leap of a clown in six different positions. He catches a horse on the gallop, a rabbit on a run and a bird on the wing. By means of a wire a circular saw or a locomotive may be—nay, has been—run miles distant from its source of force. Electricity is born of the sun. It may be converted back to its source, so that when one talks by telephone he may see his distant colloquist. It is shrewdly believed that nerve power depends for increased strength on light. It will not be strange if the polyscope illuminates the animal organism, rendering the body transparent. The vast current of liquid force which we call electricity is condensed in boxes like desiccated meats, or spread over continents to convey intelligence. Man can never overdraw from this vast, bankruptless depository of nature. Is it in vegetation? The electric light gives no interval of repose for the growth of fruit, leaf and flower; no sleep for berry or plant between eve and dawn."

Curious Electrical Phenomena.

A gentleman residing in the vicinity of Thirteenth and F streets northwest, in this city, relates the following incident in connection with the electric tempest of last Thursday evening: "I was reading the evening paper, when my attention was attracted toward the window situated on the north side of the room, and near which my wife was standing, when a blaze in the northern sky appeared in the shape of a white ball of electric fire passing rapidly toward the earth—as I judged it would have struck in the neighborhood of Massachusetts avenue and Twelfth street. When within 1,500 or 2,000 feet of the earth it exploded with the noise of a hundred-pound rifle gun and burst into thousands of fragments. Its altitude was about 45 degrees, and I might be mistaken in calculation, as these events passed with the rapidity of thought. When the explosion occurred my wife was facing the east, and at the instant she appeared to be enveloped in an atmosphere of burning sulphur, and I observed that there was no reverberation of sound as is usual with an electric stroke, but a sharp incised concussion like the sharp ring of rifled artillery, a blaze of lurid light, and nothing subsequent except the furious wind-storm which was then at its height. The effect upon my wife was peculiar. The blue sulphurous appearances passed almost instantly away, leaving her lips livid and her pulse accelerated to at least 160 per minute. In a few hours she recovered, and no ill effects were visible."—*Washington Republican, June 25*

THE
ELECTRICAL WORLD,
PUBLISHED WEEKLY AT
No. 9 MURRAY STREET, NEW YORK.

W. J. JOHNSTON, Editor and Publisher.

NEW YORK, JUNE 30, 1883.

CONTENTS.

ILLUSTRATED ARTICLES: PAGE.
Electric Street Cars....403
Electric Lighting.—XXIX....405

EDITORIAL:
Expert Quackery....406
Professor Gandini's Improved Battery....406
Mr. Edison on Electric Lighting....406
The Underground Question in Court....406
The Imperial Dictionary....407

MISCELLANEOUS:
Secondary Batteries and the Electrical Storage of Power....404
A Talk With Edison....404
New Electro-Dynanometer for Very Feebie Alternating Currents....404
Mr. Edison's Opinion of Electricity as a Motor....405
The Electric Wonders of the Age....405
Curious Electrical Phenomena....405
The Electric Light in the Home....407
The Underground Controversy in Philadelphia....407
Cable Messages....408
Maxim's Exploit....408
Dorsett's Underground Electric Conduit....408
The Telephone and the Telegraph....409
The Electric Light and the Equine Race....409

DEPARTMENTS:
The Telegraph....409
The Telephone....409
The Electric Light....410
Miscellaneous Notes....410
Electrical Patents Issued....410

NEW ADVERTISEMENTS.

J. F. Fairman.—Electrical Goods For Sale....411
Pride, Fraleigh & Kyle.—Telegraph Engineers....411
Narragansett Machine Co.—New Foot Lathes for Electricians....411

EXPERT QUACKERY.

The oldest of the sciences, medicine, has always been infested by a class of unscrupulous men whose profound ignorance is only equaled by their fabulous pretensions. In their profession they are called quacks, a term which has its uses in the younger sciences also, since harpies flock wherever the field looks inviting.

A species of counterfeit of this description bears the "brand" of our science and is actively engaged in duping unsuspecting victims. We mean the quack expert. There are two classes of this genus humbug. The first is composed of exotics who have come into the field from various quarters to do the "experting" of electrical science, just as many inventors, coming from the same points, have complacently assumed the task of doing the "inventing" for us. These patronizing individuals have fled their legitimate sphere like unsuccessful politicians who seek a new party as the "balm in Gilead." They are the men who continually tell us that "electricity is only in its infancy," and they act as though they had come on purpose to take charge of the "infant," not realizing that it is already too well nursed and that a little "let alone" treatment would do the precocious elf more good than quack medicine. They are full of self-confidence, and an alloy of presumption and brass fills the space nature originally intended for the storage of knowledge. They constitute pure and undiluted quackism.

The second class is composed of men who have some standing in other professions, but are not sufficiently skilled in electric matters to be really capable of giving valuable opinions. There is some genuineness about these men, and in nearly all cases they are entirely consistent. Nevertheless, they are the more dangerous class of the two, as whatever favorable reputation attaches to their names gives their opinions as experts fictitious weight, while the incompetency of the other class is evident and unmistakable.

The expert is a controlling power in our science, or rather in its applications. He is the arbiter, the referee, to whom all questions of importance are presented. He is the mediator between the inventor and the capitalist, and to him falls the duty of discriminating between the good and the bad. To do this accurately and justly he is often obliged to analyze most intricate problems. Therefore, it is important that he should be qualified to give correct, consistent and logical opinions, that he may not make deplorable blunders. If he endorses what is worthless, the reputation of the science suffers even more than his own. If he fails to give due credit to what is worthy, the science suffers injustice. The clear-brained, intelligent, trained expert is a valuable factor of progress, and an honor to science. His opinion is to be relied upon and is valuable. The quack expert is a disgrace to himself and society, and a pitfall to the public.

Unfortunately, the person desiring advice cannot always discriminate between the spurious and the genuine expert, and so stumbles into trouble, while thinking he is avoiding it. He follows the advice of his quack expert until he finds it worse than worthless—knowledge that usually costs him a round sum. If the expert's ignorance is not to blame, what is? Yet it is not always ignorance that does the mischief. Hypocrisy and collusion contribute to the disastrous result. The quack accepts a "retainer" from those interested in obtaining a certain opinion. He is examining the features of an invention for capitalists, for instance. The retainer from the inventor or his friends is not given to influence the quack; of course not. It is merely to induce him to "take a little interest" in the invention; to look over it "more carefully." It is surprising how very "carefully" the invention is looked over after this "initiation fee" is paid! Its advantages are so much more perceptible, while demerits are conspicuously absent.

Incalculable damage has been done the science within the past few years by expert quackery. The great number of bogus electrical schemes which have been launched on the market, and buoyed up by expert "gas" bought and paid for, have bled capitalists and made them shy of further financial dealings with electricity. It is owing to the exploits of the quack expert that a really good thing is now received with so much suspicion, and often lingers in development for want of encouragement. Public confidence in experts has been destroyed, and thus do the honest suffer for the misdeeds of the unprincipled.

This condition of affairs should not be tolerated by the public. Better discrimination will eradicate this abuse. The lack of judgment on the part of those who employ experts has fostered quackery.

We trust a simple ventilation will purify the odor of the expert business, without a course of active disinfection. Meanwhile, those who are called upon to express opinions should be conscientious with themselves and candid with their customers. The best and most lasting reputation is always *founded* on consistency and honesty.

Professor Gandini's Improved Battery.

An Italian scientist, Professor Gandini, lately proposed an interesting modification of the Bunsen battery, which he claims does not lower its electromotive force and still renders it more constant. The Bunsen battery is very constant when first set up; but in a few hours the bichromate of potash solution becomes diffused through the porous cup and into the sulphuric acid solution, and polarization is more liable to occur, while on the other hand the zinc is attacked more vigorously. This is undesirable where the battery is needed at periodic intervals for a long time. In the battery of Prof. Gandini the zinc is placed in pure water and the carbon in a strong solution of sulphuric acid and water, to which is added about one-twentieth of nitric acid. The vessel is covered with a wooden disc soaked in sugar, in order that the nitric acid fumes resulting from the chemical reaction may be rendered harmless. The current from this battery reaches its maximum of intensity only slowly when first set up, but after the maximum is reached it will remain constant for many days, especially if its use is not excessively protracted and if the battery is not worked on a circuit of too low resistance. It is said that the constancy of this battery is much superior to that of the Bunsen. As stated above, the electromotive force of this battery is equal to that of the Bunsen, but its internal resistance is at first slightly higher. This higher resistance is accounted for by the fact that the pure water around the zinc is such a poor conductor. After the battery has been standing some time a partial diffusion of acid takes place through the porous cup, and the conductivity of the water is thereby increased. With three small cells of this type, weighing altogether not over five pounds, it is said that Prof. Gandini has kept a small Swan incandescent lamp lighted for several hours. This form of battery would probably be also well adapted to electric motors. In a further modification, Prof. Gandini employs a cylinder of iron in place of a cylinder of zinc. The use of iron as an electro-positive metal had long ago been suggested and adopted by Schönbein, but it had not been found very practicable, as when placed in acidulated solutions the iron would dissolve with equal readiness whether the battery was in use or not, just as zinc does when not amalgamated. In the Gandini battery, the solution is at first pure water, and as the diffusion takes place very slowly, the iron is not likely to dissolve uselessly to any great extent.

We would like to suggest that this battery would be very much improved in efficiency and durability by using, instead of pure water for the zinc or iron, a saturated solution of common salt. Ordinary sea water would be a most excellent substitute for the pure water. Solutions of salt and sea water are among the best of conducting liquids. Such solutions have been frequently used instead of sulphuric acid solutions in the Bunsen battery, and with great advantage. A battery using iron and salt water in one compartment with carbon and the sulphuric-nitric acid solution in the other would undoubtedly prove very highly efficient, while it recommends itself to experimenters on account of its cheapness.

Mr. Edison on Electric Lighting.

Mr. Edison is reported as saying in Chicago the other day: "About six weeks ago I closed my laboratory, and I have now got the system worked down to the minutest detail. There is nothing more in electric lighting to be invented or required." This is a surprising remark to come from Mr. Edison; for about eight months ago we quoted in these columns from a little book, entitled "How to Succeed," in which he is represented as saying of the inventor: "He can take hold of almost anything, the steam-engine, for instance. Probably a million men have already worked at it. That would not deter me in the least; because that which is known to what is possible to be known stands, we will say, as one to ten millions. The best method of doing almost anything you can mention in mechanics has not yet been found out. * * * * * The mind of man is so almost infinite that the field is unlimited."

If Mr. Edison is candidly of the opinion that "there is nothing more in electric lighting to be invented or required," there is a strong probability that he will awake at no very distant day and find that the Edison system has been left behind by inventors who have acted upon his own advice as above quoted. The truth is, there is yet much to be invented and required in electric lighting, even in that branch of it which Mr. Edison has made his specialty. To give but a single specification, we may remark that isolated lighting appears to be in its infancy, being confined, as yet, to large establishments, vessels, etc., equipped with powerful machinery.

Still, while it would without doubt be a loss to the cause of electric lighting for Mr. Edison to withdraw his attention from the subject under the impression that nothing more remains to be accomplished in that line, if he will apply his apparently inexhaustible energies to his other inventions, some of which are languishing, the world will not be wholly the loser. There is the phonograph, for instance, concerning which Mr. Edison was reported, some months ago, as having said that he had merely laid it aside until he could find time to develop it. The phonograph is an instrument of great promise. We all remember with what *éclat* it was ushered into existence, and what a brilliant future was expected of it. There are so many competent minds now engaged upon the problems of electric lighting that Mr. Edison can well be spared from the field, if he will redeem the promise of the phonograph and give it a practical value.

As we have before pointed out, however, Mr. Edison's public utterances, whenever they may have any bearing upon the commercial status of the Edison Electric Light Company, are to be received with a grain of allowance, and the present is probably a case in point. Doubtless he will himself continue to contribute to the development of the electric light until it shall really and truly "shine for all."

The Underground Question in Court.

There are various methods of procedure open to those well-meaning persons who are desirous of having all electrical wires placed underground. One way is to induce the municipal authorities to issue an edict summarily ordering them to be put there. This is the method adopted in Chicago, and which has, so far, not only proved ineffectual in that city, but has developed a very unsavory state of affairs in the city council. A slight objection to this method is that it entirely ignores any rights the electrical companies have. A better method is that chosen by the Board of Trade, of Philadelphia, which has instituted a suit in the courts to secure the removal of the poles erected by the Brush Electric Light Company on Chestnut street and other thoroughfares of that city, on the ground that the poles are a needless obstruction to the public highway, which the Councils had no right to authorize. The learned judge before whom the case came has informed the counsel for the plaintiffs that before a decision can be reached it will be necessary to

submit testimony showing the practicability of an underground system, and steps are being taken to procure such testimony, mainly in the city of London, where it is believed the largest experience with underground wires has been had.

The city of Philadelphia was among the first to introduce the electric light for street illumination. It has made Chestnut street one of the most attractive in the country after nightfall, and notwithstanding all that the journals of that city have said about the injurious effects of the light, in producing freckles on shop-girls, tanning policemen and causing street-car horses to become cross-eyed, it certainly is a public benefit, and as such is entitled to consideration. If the suit instituted by the Board of Trade shall result in giving us some judicial wisdom on the vexed question of underground wires, based upon competent testimony, that body will merit the thanks of the entire community.

The Imperial Dictionary.

The latest edition of the Imperial Dictionary, published by Blackie & Son, London, and the Century Company, New York, is a publication of great value to both the general reader and the scholar. It comprises about one hundred and thirty thousand words, or separate entries, and is the most copious of the great dictionaries of the English tongue. The vocabulary includes the latest terms employed in science and art, as well as words now generally out of use, though found in early masterpieces of prose and verse. Readers in every department of information or literature will certainly find in this lexicon the instruction they seek; and also that the definitions are given with a surprising fullness. Careful etymological researches have been made to give completeness to a book intended for the use of people of letters; and, in all cases admitting of it the word defined is made the suggestion of a paragraph presenting much information in a concise form. In fact, the Imperial Dictionary is an encyclopedia, the value of which is augmented by upward of three thousand engravings printed in the text. Reading this dictionary is a luxury to the fortunate possessor of the work. The best authors are placed under contribution in its numerous quotations. After careful examination and comparison, we state, without hesitation, that it is the most complete work of its kind yet produced. It is arranged in octavo pages, in four volumes of convenient thickness, and is beautifully printed in a variety of type, giving ready distinctness to the word defined and the several divisions and kinds of information following it.

MR. MAXIM'S heroic capture of the burglar, described in another column in an extract from a London journal, is one of the most interesting scraps of literature in which an electrician ever figured. No better index to his character could be given. Courage, persistence and a never-yielding will were all called into play in that long and desperate grapple. An exchange, speaking of the adventure, says: "There is not a detective in the world who might not be proud of his achievement, and as an exhibition of what is known as pure grit it has seldom if ever been excelled. It is easy to understand how Mr. Maxim has succeeded as an electrician now that his tremendous will power and indomitable courage have been revealed in his capture of the knave who robbed him."

WE are short of copies of THE ELECTRICAL WORLD of April 21 and June 16. Any of our readers who can send us a copy or copies of either or both of these issues will confer a favor. Put your name on the wrapper, and we will extend your subscription to correspond with the number of copies you forward.

The Electric Light in the Home.

Mr. John Munro, C. E., who is a frequent contributor to the English electrical and scientific journals, recently read an interesting paper before the London Athenæum Society on the above subject. The electric light, he said, whatever its demerits in its present stage, and in spite of some public apathy just now to its advantages, is obviously our future light-in-chief. It is our nearest approach to an ideal light, that is to say, a light pure and simple, free from burning and the decomposition of chemical bodies, a light produced by the simple excitation of the ether which is the source of all our light.

For household purposes the incandescent lamp is, of course, the best, as Mr. Edison foresaw in 1878. The arc lamp, with its intense glowing arch of carbon vapors, is a step beyond the candle or the gas flame in point of purity, and vastly superior in point of brilliancy; but there is combustion here, too, and certain noxious fumes and red hot sparks are given off during its action. Though suitable for lighting public spaces, streets, yards, and lighthouses, it is not adapted to the home. The incandescent lamp, in which the light is produced by a white-hot carbon filament traversed by the current in a vacuum tube or bulb of glass, is manifestly our household light, at least until we get a better.

Its merits lie in its healthiness, its safety as compared with gas, and its intrinsic beauty.

The healthiness of it is absolute. The hermetically sealed glass globe inclosing the white-hot wick or filament does not permit the light either to pollute or to consume the air. A gas or candle flame not only burns the air in a room which should be breathed, but pollutes the air which is left to be breathed with smoke, carbonic acid, and other gases. People are hardly alive to the deleterious influence of gas-jets on the health. We often hear, it is true, of headaches and lassitude, produced by crowded rooms and gas-burners; but the slow poisoning these produce is as a rule overlooked, because it is not easily traceable, and cannot very well be avoided so long as gas is used. With the incandescent lamp in our homes we shall be able to breathe a fresher, healthier atmosphere there, and visits to the theatre or lecture hall lit by the same means will not be undertaken at the risk of headache and nausea. The comparative coolness of the light as compared with gas must also be considered in its favor in respect of healthiness; for the oppressive heat of assembly rooms is generally due to gas-light. A number of people crowded together are sufficient to generate heat enough to keep themselves warm except in cold weather; and heat, if it be wanted, can be supplied by special means without depending for it on the means of lighting. The cleanliness of the incandescent light is also an advantage, though a minor one, perhaps. It has no oil to spill or smoke to settle upon furniture, and the glass bulb can easily be kept clean.

The safety of the electric light as compared with gas requires little demonstration. It is not, of course, absolutely safe; for an accident to the wires might cause a spark to develop and set fire to something inflammable. But it is free from the terrible explosive power of coal-gas or petroleum; and it must be a very inflammable substance which will ignite by the electric spark. The wires will be carefully insulated according to rules laid down beforehand; and it has been shown again and again that if the lamp itself be broken, the white-hot filament is dissipated by the inrush of air into the vacuum, and nothing is left to set fire even to the lightest gauze or muslin.

As for the danger to life and limb from electric shocks produced by the current, that can be avoided by employing currents of lower electromotive force than will prove fatal to the tissues of the body. There are one or two systems of lighting in which "high tension" currents, which might kill, are used, but there are many other systems on which the light is produced with perfectly harmless currents; and these are likely to prove the fittest in the end; for, give the public an equally good light which is free from peril to the body, and they will certainly choose it in preference to one which was a kind of lurking death.

The beauty of the incandescent light is another of its merits. The rich golden glow of the carbon filament resembles the light of a wax-taper; only it is not blown about by the air and requires no snuffing. The steadiness is equal to the brightness of it. Being fumeless, it does not tarnish gilding, and thus it can be used in picture galleries and richly ornamented rooms where gas would be prohibited. Great expense in re-gilding public halls and dining-rooms will thus be saved by its use. Moreover it can be used with impunity in libraries where gas would rot the leather bindings of the books in five or seven years.

It lends itself very readily to decorative purposes. Wherever a wire can be led it can be taken; and we may see it burning in the midst of flowers, ferneries, trees, or in the water of aquaria. The floral chandelier, on which the incandescent bulb is shaded by the cup of various flowers in colored glass, is already a well-known form of ornamental lamp-holder, and workers in brass have opened up a new branch of business in designing electric light fittings. Workers in glass, too, have a new field here, in preparing colored shades of different tints for ornament, or for such purposes as photography, and for scenic effects.

I do not propose to enter into the question of expense, or the methods and means of supplying the light, further than to say that the expense will be no obstacle when lighting operations are begun on a large scale, and that the most reliable method of lighting a house is by means of a generator. The latter may either be a dynamo-electric machine, or the hitherto neglected primary battery, which has the great advantage for isolated installations in requiring no motive-engine, with its drawbacks of noise, smoke or fuel. The measurement of the current can be effected by such electric meters as have been devised by Edison, Boys, Hopkinson, and Professor Ayrton and Perry. Current-meters will be used to measure the quantity of current supplied; and energy-meters if the electricity is also to be used for motive-power, such as the driving of lathes, sewing machines, punkahs, and so on. This double service of the electric current is likely to prove of much convenience, and will probably give rise to quite a number of labor-saving devices for household use in future.

The electric incandescent lamp is so light and movable that it will be very handy in the home. If a person is an amateur mechanic, or photographer, or microscopist, he can adapt it readily to his lathe, his developing closet, or his microscope. Mr. Stearns has fitted the Swan lamp to the microscope with much ingenuity and success, and Mr. Stanley has also succeeded in photographing microscopic images very well with it by aid of a lens or two, and without using a camera.

In the library it will be especially useful for reading by; and as it can be switched from one lamp to another in a room wherever it is wanted, not more than a single lamp need be used at a time in many cases; for the light can be directed to the point where it is wanted. It cannot, of course, be carried about in the hand as easily as an oil lamp or candle, unless indeed flexible cord conductors are used, and it cannot yield a light for a cigar or cigarette; but these are trifling drawbacks which the humble match and candle will make good.

Some time ago an American physicist, Professor Pickering, investigated the cause of the bad eyesight so common among Harvard students, and traced it to the heat given off by their reading-lamps. Heat, not light, was the source of trouble, and it appeared to act by drying the moisture of the eyes. He therefore concluded that the electric light would be better for the eyes than gas or oil lamps. But it is a common remark among electric light engineers that their sight is growing poor; and there is no doubt that looking at electric lights is very injurious to the eyesight, temporarily at least. Here the cause is obviously not heating, and the recent experiments of M. Chardonnet, communicated to the French Academy of Sciences, would seem to point to the ultra-violet or actinic rays as the cause of the evil. M. Chardonnet finds that the ultra-violet rays are absorbed by the crystalline lens of a healthy eye, and as the electric light from the "arc" lamps is excessively rich in these rays, he infers that the lens must be injured and too much taxed by the light of an arc lamp. The light from incandescence lamps, such as those of Swan, Edison, and others, is not rich in these rays, and is therefore in his opinion better adapted for homes. As it gives off little heat either, it is evidently the kind of reading-lamp for persons with weak eyes. But in spite of the heat and actinic rays, we are inclined to think that the very brilliance of the electric light is detrimental to the eyes, which suffer from excess of light. Therefore it is that on looking at the glowing filament of an incandescence lamp the eyes are dazzled for some time to come; and hence it is advisable to screen or shade the white-hot filaments from the line of sight.

The electric reading-lamp exhibited here to-night has been devised by the author, and made by the Duplex Electric Light, Power and Storage Company, of Soho Square. It consists of a mahogany base, inclosing a battery of seven cells, of the kind arranged by Mr. G. V. Holmes and Dr. S. H. Emmens, and consists of six-sided cells of carbon, each containing a zinc rod in a porous pot immersed in the exciting solution. From this base rises a light tubular standard of metal, carrying a jointed arm, to the end of which is attached the lamp by a socket. A movable screen to shade the filament and reflect the light is supported over the bulb by a smaller jointed arm. It will be seen that the lamp, which gives a good light of several candle-power, can be readily brought to any position with respect to the reader by reason of the joints in the arms and the turning-joint at the foot of the standard, which enables it to turn round its axis. The lamp also folds up into a slot cut in the upper part of the standard to admit the folded arm, and can in this way be transformed into an ordinary table-lamp.

The Underground Controversy in Philadelphia.

The following communication, addressed by Mr. W. A. Stern, an electrical engineer of Philadelphia, to the members of the Select and Common Councils of that city, will be interesting to electricians:

GENTLEMEN:—In consequence of the near termination of your long controversy on the question of putting telegraph, telephone and electric light wires underground, and my fear that you may have been misled or prejudiced by the great number of side-show exhibitions of the different systems presented before you, in addition to the charlatanry resorted to in the articles on the subject appearing in daily print, I deem it my duty to say something on the question.

Nor do I blame you for having formed such favorable opinions. On the contrary, I do not see how any one, save an electrical expert, could come to any other conclusion, after reading the numerous articles, or rather the one-sided controversy, than that the running of underground telegraph, telephone and electric light wires is not only thoroughly practicable, but that it has been done and with great advantage and economy over the present system of aerial lines. In fact, that it is through its experimental age, and is now a grand success.

It is my intention in this communication, in addition to showing you that there is absolutely no system, claiming to place telephone, telegraph and electric light wires together underground possessing sufficient merit to be used practically and commercially, that it will be detrimental to the interests of the people, to grant permits to these various companies, as it will be a means of tearing up the streets and inconveniencing the public, and will have only the effect of enabling the representatives of these various systems to better manipulate their stock, for they will never be used as a system of underground telegraph.

Although exhibitions of these systems have been given and demonstrated satisfactorily to people, as they thought (by the short time exposed) that telephone, telegraph and electric light wires could be successfully placed in juxta-

position to one another, it has been no data or satisfaction at all to the electrical engineers, for the reason that the factor of time enters strongly in pronouncing tests of this nature satisfactory, as I show below. And why should electrical experts not be asked to examine and look into so important a question as this? Certainly, electricity should now be recognized as a separate and distinct department of engineering, and since in anything mechanical or scientific the city has always had its engineers appointed to investigate the same, I do not see why it has not done so in this. To this some one might reply that there were electrical experts at all these tests and they were said to have considered them highly satisfactory. If such is the case it reflects very poorly upon the scientific ability of these engineers. Who were these experts? They are not known generally to the electrical world, and from none of them have we received a report based upon the scientific condition involved. At none of these tests have such experts as Professor Geo. F. Barker, of the Pennsylvania University, or Professor Henry S. Morton, of Stevens Institute, or men of their kind, been asked to examine the merits of these systems. Before any concession of street privileges be given these various companies, Councils should appoint a committee, composed of scientific electrical men as well as practical engineers, whose duty it shall be to report fully upon the scientific conditions of any system, and also on the overcoming of all mechanical obstacles in the way of running them, for the reason of allowing space to only those that have merit; for we are rapidly advancing in the application of scientific principles to the industries. And many years will not elapse before all agents such as heat, steam, cold air, electricity, will be served to the individual's quarters from a central generating point as gas and water are to-day. And in anticipation of this view it is safe to remark that the street area available for the introduction of all these various inventions is so small as to require the greatest amount of judgment in placing the different pipes and conduits, etc., to insure our getting the benefit of all improvements in the sciences by having enough room in our cities to allow their introduction.

But in all systems that have been presented to you, which claim to run successfully telegraph, telephone and electric light wires together, there has been absolutely nothing done towards the improving of electrical imperfections. In fact the great number of patent specifications on this question seem to differ simply in quality and nature of material used for conduits, and manner of making same, while no attention has been paid to the better insulating of the conductors, the most important part of all, since they are to be placed alongside the high tension and dangerous currents of the electric light wires. If we have once found a means of covering a wire so as to last a number of years and offer such a resistance to the passage of the current from the wire, or, in other words, make the leak from the high-pressure electric light currents to the telephone circuits trifling, we could simply then throw them in the ground any place without the need of those beautifully shaped holes of the present underground system. In short, that is the whole invention, a piece of concrete or other non-conducting material, with a number of prettily-shaped holes.

To place electric light wires with those of the telegraph and telephone would not only be commercially unsuccessful, but would be very dangerous. There is no such thing as an absolute non-conductor of electricity, but in comparing with good conductors, some materials are for practical purposes considered insulators. Now, if we were to have electric light wires come in contact with those of the telegraph and telephone, a slight amount of electricity will leak from one to the other. And since electricity in its passage along a conductor is converted into heat wherever it meets resistance, would have this effect just at the point of the crossing. And in consequence of the insulating materials consisting mainly of carbonizable materials, there would be a tendency due to the heat to produce a slow conversion into carbon. When this is complete it is a fair conductor, and allows the heavy current to pass to the telephone line in large quantity, where it again encounters more resistance at the instrument, is again converted into heat and will in all likelihood set fire to office, house, or wherever the telephone happens to be placed. It would certainly have the effect of increasing the rates of insurance on any building in which such a wire terminated, and our merchants now feel as though they were paying sufficient for the use of this indispensable service.

Aside from all the objections mentioned, not one of these systems means an absolute doing away with all overhead wires. It simply disposes of the least objectionable ones while making no provision for the house top or dangerous wires. You all know what obstruction these offer to the firemen. In addition to this anything strictly underground would mean the tearing up of one's pavement and street every time a telegraphic or telephonic apparatus is to be inserted into a house. And I consequently hope that we will not be obliged to suffer this inconvenience until we have a system that is complete. I strongly favor underground electric wiring, but not until we have a good system, and conscientiously say that that time has not yet arrived.

Respectfully submitted,

W. A. STERN, Electrical Engineer.

PHILADELPHIA, June 25, 1883.

Cable Messages.

A reporter of the Hartford (Conn.) *Post* being in the Western Union office at that place when a man sent a message to Paris, was moved to inquire as to the methods of sending dispatches from obscure points to great foreign centres.

"In the first place you must know," said Mr. Curtis, chief clerk of the office, who has charge of the transmission of foreign dispatches, "that messages to be sent from Hartford across the ocean go from here direct to the main office at New York, and are there sent to the point of destination by the cable lines. From the United States to Europe there are six cables in all. Three, known as the Anglo-American lines, run from Heart's Content to Newfoundland, to Valencia, on the southern coast of Ireland, and thence to London. Another cable runs from Rye Beach, Mass., to Tor Bay, Nova Scotia, and thence to Valencia. The French cable starts at Duxbury, Mass., extends to St. Pierre, Nova Scotia, and thence to Brest. Mr. Jay Gould laid a cable last summer which gives additional telegraphic communication with Europe. London is the general distributing point for foreign messages, and from there they may be transmitted all over the world."

"How would you send a message to Hong Kong in China?"

"There are three routes by which this may be done," answered Mr. Curtis, taking from a shelf a volume, many pages of which were covered with outline maps, upon which the telegraph routes were designated by colored lines, red lines indicating the water and blue the land routes. Turning to a map of Europe and Asia, he continued: "If you will look at this you will see at once how a message may be sent to Hong Kong. First, let us take the Siberian route, which is built across the steppes of that barren country and maintained by the Russian Empire. First, the dispatch goes from New York to London. Thence under the English Channel and across the Netherlands to Berlin. Then on to St. Petersburg, Warsaw and Moscow, and across Russia in Europe and the vast territory of Siberia, until it is safely received in Nagasaki, in Japan. Then by cable it hastens along the Chinese coast, through Shanghai and Amoy, until it finally reaches its destination in Hong Kong. If you wish the message to go to Yeddo or Yokahama it will be sent over Japan from Nagasaki. Another route to Hong Kong is the 'Teheran' line. The message, as I have already told you, goes from here to London, and thence across Western Europe to Constantinople. From the Turkish capital it speeds along to Teheran, in Persia, and thence through Beloochistan to Bombay in India, where it unites with what is known as the 'Falmouth' route and at last reaches Hong Kong. The Falmouth route is almost entirely under the water. It starts in England from the city after which it is named, extends by cable to Lisbon, in Portugal, thence under the ocean through the Straits of Gibraltar, the Mediterranean Sea, the Suez Canal and the Red Sea to Aden. From Aden the cable passes beneath the Arabian Sea to Bombay, and there the route unites with the Teheran, and the two lines become one and pass on to Singapore and Java. At Singapore a cable to the northward goes to Hong Kong, while the main line keeps on to Port Darwin in Australia, and crossing the great island opens communication with Sidney, Adelaide and Melbourne, and finally with New Zealand and Tasmania. You will see by the map that the three great routes, the Siberian, Teheran and Falmouth, make communication with the far countries certain at all times."

"How is South America reached?"

"Formerly all messages from the United States to South America were sent to Brest, from there to Portugal, and thence via Maderia and the Cape Verde Islands to Pernambuco, in Brazil. Then coast-line cables carried the dispatch to Bahia and Rio Janeiro, until Montevideo was reached. Then a 'land line' passes over to Valparaiso, in Chili. But lately a cable has been laid from Galveston, Tex., across the Gulf of Mexico to Tampico. Thence through Nicaragua to the Pacific Ocean and along the entire western coast to South America to Valparaiso. This route has just been finished, and the cost of transmitting messages reduced 75 per cent."

"What is the charge for messages?"

"To all parts of England and France, 50 cents per word, To Hong Kong and any other place in China, $2.50 per per word, and to Japan $3 per word. By the old route the tariff per word to South America was about $7, now it is reduced to $1.50. Nearly all of our foreign dispatches are upon mercantile matters, and a cipher is generally used by the senders, by which a single word often conveys the meaning of an entire sentence, and by this means the actual cost is greatly cheapened."

In regard to the space of time occupied in transmitting a message, Manager Lounsbury informed the reporter that to England and France an ordinary dispatch is sent in about twenty minutes, and answers have been received within an hour. As showing the accuracy and speed attained by the systems, he related an incident of a dispatch sent in the Turkish language by a Turkish gentleman from Hartford to a point in the Black Sea. The Turkish words in the message were spelled in English, and were, of course, unfamiliar to the operator in the office, yet Mr. Lounsbury subsequently learned that they were received identically as spelled, and notwithstanding the many transfers to which they had been subjected, exactly as the sender wrote them.

Maxim's Exploit.

A Paris dispatch to the London *Standard* says that the passengers by the night train to Dieppe on the Tuesday before witnessed a most exciting struggle. In 1881 Mr. Hiram S. Maxim, the electrician, was robbed of 10,000 francs while at the Grand Hotel. One of the thieves was a tall, stout man, calling himself an American naval captain. Mr. Maxim gives the following graphic account of his exploit:

"On the evening of the 5th inst. I left Paris for London, via Dieppe and Newhaven. Upon the arrival of the train at Rouen I alighted, and noticed a group of five Englishmen standing at the refreshment bar. Two of these I at once recognized as the men who had robbed me. Without delay I seized upon John Palmer and called for the police, stating to the by-standers that I was capturing a thief who had robbed me, and I asked for a policeman, but none was to be found. The interpreter at the station, however, said he would fetch one, but before the policeman arrived the four others had entered their carriage and the train started. When the train had got up a fair speed Palmer, whom I held, made a tremendous effort, slipped out of his coat, leaving it in my hands, and rushed for the departing train. I pursued him, and, gaining on him, caught him just as he got on the foot-board. He made a desperate attempt to throw me under the carriage wheels or beat me off. I succeeded, however, in gaining a firm foothold, and, passing one arm through a window, I held on to the thief with the other hand. He could thus neither throw me off nor get off himself. The train ran rapidly into the tunnel, and I found myself in darkness. Many passengers looked out of the window and screamed. The great confusion caused a signal to be given to stop the train, and when the speed sufficiently slackened I jumped off the footboard, dragging my prisoner with me, and notwithstanding his vigorous exertions to escape, I forced him out of the tunnel, where I was met by the interpreter. Upon my arrival at the station two policemen put in an appearance, but I did not relinquish my hold of the prisoner until he was safely handcuffed. I earnestly requested the police to telegraph to Dieppe in order to arrest the remainder of the gang on the arrival of the train at that town, but to no purpose, as an hour and 20 minutes elapsed before I could induce them to take action, and even then I had to pay for the telegram myself. On the way to the police station the prisoner conversed freely with me, and said that if I would refrain from accusing him he would refund my money and pay all expenses I had been put to. He added that he wanted to go to London and not to Paris; that I should gain nothing by detaining him, but if I released him I should make something out of it—in fact, something handsome. I told him that it was not a question of money with me, but a matter of principle, and that I should prove he had robbed several of my countrymen; that it was only just that he should be punished, and that he would probably be an older man than he then was before he again visited London. Upon being taken before the Chief of Police he pleaded guilty, and will probably soon be brought to Paris for sentence. The only injuries which I received during this fierce and protracted encounter was the turning back of three of my finger nails and tearing the sole from one of my boots."

Dorsett's Underground Electrical Conduit.

Several hundred feet of Dorsett's underground electrical conduit are being put down in Chicago for the purpose of demonstrating its practicability. The compounded material of which it is composed was patented by Mr. D. H. Dorsett several years ago, for use in the manufacture of sewer pipes; and he recently secured several patents on its application to underground electrical uses.

The concrete consists of bitumen, silica, paraffine, and manganese didride, and when properly compounded and tempered has great strength. The conduit consists of a cylindrical body of the concrete, through which extend parallel holes a quarter-inch in diameter, each hole being separated from the others by three-fourths of an inch of the material. The outside holes are one and a quarter inches from the surface of the cylinder, which is made in five-foot lengths, and in sizes to carry 32, 100, 150, 200 and 250 wires. One end is smooth and of the same size as the body; the other has a bell-shaped flange to receive the smooth end of the next cylinder. The perfect mechanical and electrical union of the ends of the cylinders is accomplished by machinery specially designed for the purpose. First each hole in the two cylinders is joined by an insulating tube; then into the space between these tubes, between the two cylinder ends and between the flange of the one and the body of the other, a quantity of the melted concrete is forced, under heavy pressure, which unites the two cylinders as solidly as though they had been molded in one instead of two pieces.

Hydraulic tests show these joints to be absolutely im-

pervious to moisture, and of actually greater mechanical strength than the body of the cylinder. The conduit is laid upon a foundation of timber and concrete, below frost.

The advantages claimed for this system by its inventor are many. Among them are its comparatively low first cost, the ease and simplicity with which wires may be drawn and redrawn—water-tight man-holes of the concrete being placed at convenient distances for this purpose. Wires of any kind, insulated or uninsulated, can be used, the material itself being a fine insulator of great strength, absolutely impervious to moisture, and with almost perpetual lasting properties.

Several tests of this system have been made on a small scale by the city electrician, the chief electrician of the Western Electric Company, and the electrician of the Mutual Union, all of which gave flattering results. The tests now being made will be fully described as soon as their results are known.

The Telephone and the Telegraph.

Mr. A. J. Burton, Western Union Manager in Brooklyn, N. Y., has been giving his views of telegraphy and telephony to a reporter of the *Union* of that city. Among other questions the reporter asked :

"Does the telephone service hurt your business any?"

"Not a bit of it," replied Mr. Burton. "Last month, for instance, we sent 65,000 messages from Brooklyn, which overlaps that of last year the same time by many thousands. The fact is, the telegraph and telephone are working together. Every one uses either one or the other nowadays instead of the comparative few who used to use the telegraph only for important purposes. We have kept cutting down rates from the start until now it must be only the very poor who cannot avail themselves of the telegraph."

"How does the telegraph compare with the telephone in swiftness of transmission?"

"Well, it was supposed when the telephone was first publicly introduced that the Morse system of telegraphy would be done away with, but we find that we can transmit faster by the Morse instrument than they can by telephone, because messages over the telegraph come in steady without the frequent interruptions of the telephone from lack of distinctness, atmospheric and other conditions. You know what time is wasted from constant repetitions of questions and answers over the telephone. There is very little of that on the Morse telegraph. But the telegraph and telephone do not interfere with each other, and both are constantly growing in use. The more facilities increase for rapid communication the more will be the demand upon them. It is an electric age, and every one wants to send things speedily."

The Electric Light and the Equine Race.

"Cross-eyed? Yes, there's something in the idea," said a Chestnut street car-driver when interrogated by a reporter of the *Philadelphia Times*, as to the effect of the electric light on the horse. "I was raised among horses, but I never saw a cross-eyed one. Now, I don't say as these 'ens look cross-eyed, but they act so. Why, when we gets down to Front street and swings 'round to Walnut the horses often has to be changed to the other side to prevent 'em crowding each other. Does it interfere with the business? Well, I should say it did. The two horses look for passengers on the same side, you see. Do the horses see the passengers? Yes, they are on the lookout, same as the drivers. I don't know what this cross-eyedness may lead to. Some of the boys was a-sayin' to-night that John Norton, the stable boss, had to change the feed-boxes of some of the horses on the night line to the off side, so the cross-eyed horses could find them. If this electric light freckles the girls on Chestnut street, it is not so queer that it injures the horses' eyes. Good evening."

THE TELEGRAPH.

MESSENGERS.—Some of the employers of messenger boys in Cincinnati are thinking of putting side-blinkers on them, *à la* horse bridle, so they may not be so much tempted to tarry and inspect the attractive contents of show windows.

MARVELOUS GROWTH.—It is said that the growth of the Japanese postal and telegraph system has been marvelous. Telegraphic communication has been established between each of the chief cities of Japan, and between them and all parts of the world.

TELEGRAPHIC WEATHER FORECASTS.—In forecasting weather Mr. Rollo Russell points out that next to frequent readings of the barometer and thermometer locally, and a knowledge of the distribution of atmospheric pressure over as wide an area as may be, observation of the character of clouds, especially of the cirrus variety, is of the greatest utility. Observation of cirrus can plainly be made use of in a system of telegraphic weather forecasts.

SWINDLING BY TELEGRAPH.—Superintendent Walling, of this city, has received a printed circular from Cincinnati giving a warning against a swindler about 25 years of age, slender, smooth-faced and a plausible talker. His method of operating is to send a letter or a telegram to persons he wishes to swindle the day before he calls. When he appears he offers a them a forged check for more than his purchases, and asks for the difference. One hundred dollars is offered for his apprehension.

THE MEXICAN TELEGRAPH COMPANY.—An exchange says that there has been an increase of more than 60 per cent. in the business of the Mexican Telegraph Company during the past six months as compared with 1882. The gross receipts for the year, which ends with this month, are estimated at $110,000, which is about $70,000 in excess of the operating expenses. The semi-annual meeting of directors will be held in July, when the present board will be re-elected and the usual four per cent. dividend declared. The surplus earnings will be added to the reserve fund.

THE WESTERN UNION IN ILLINOIS.—In the quo warranto case against the Western Union, a petition was filed on the 6th before Judge Gary, of Chicago, asking to have the case remanded to the Federal Court. The petition set out that the amount in dispute exceeeds $500, and is a suit arising under the Constitution and laws of the United States, and particularly under the act of Congress of July 24, 1866, in reference to telegraphs. The suit is an attempt to deprive the company, a New York corporation, of the right to transact business in the State of Illinois. A bond was filed in the sum of $1,000, and the case will be transferred.

THE POSTAL TELEGRAPH COMPANY.—This latest rival of the Western Union has its list of new trustees made up for election at the next meeting. So many have been anxious to get in, the officers of the company say, that the Board has been enlarged to accommodate them. The Chicago line will, it is promised, be open for business next week. Vice-President Cummins announces that a contract has been signed with several capitalists for the construction for his company of two trans-oceanic cables across the Atlantic. The rates for transmitting messages across them, he thinks, will be as low as the actual cost of sending them now by the other cables.

ADVERTISING BY TELEGRAPH.—The *World* of this city says : "The enterprising showman in England has taken a step in advertising quite beyond his American brother. He now sends telegrams to private houses advising the occupants by all means to attend his performances. Staid Englishmen object to the service. Telegrams suddenly brought to a house and thrust into the bosom of a family are apt to create a flutter, and one can readily imagine the feelings of a conservative group, who have been expecting the death of a rich uncle in India, when the dispatch is brought in. It is impossible even to picture the revulsion when the head of the house tears open the envelope with trembling hand and reads : 'Dont fail to go to-night and see the Blooming Maid of Tewksbury in her song and dance.'"

THE WESTERN UNION'S TROUBLES IN CINCINNATI.—Judge Peck, of the Superior Court, at Cincinnati, Ohio, recently granted an injunction against the Western Union, asked by the executor of S. N. Pike, to prevent the company erecting telegraph poles in front of Pike's Opera-House on Fourth street. The Court said : A telegraph pole might not be a very great obstruction to the street, but, nevertheless, in so far as it does obstruct the street, its occupancy is exclusive, and inconsistent with the use of that part of the street as a street. While it may be only a small invasion of the rights of the abutting owner, it is, notwithstanding, an invasion of his rights, and for which he has a right to maintain such action as the present. The public has also a right independent of the property-owner, and it is claimed the public has granted its right to the company. But the property-owner has rights, so far as the boundaries of his property are concerned, and these are independent of the right of the public, and cannot be taken away without compensation. The Court was therefore of opinion that the plaintiffs were entitled to an injunction.

THE GOLD AND STOCK COMPANY'S THREAT.—A long and spirited discussion occurred in the governing committee of the Stock Exchange at its meeting on the 13th, in regard to the relations of the Gold and Stock Telegraph Company, which had sent a letter threatening to remove its telegraph instrument and begin suits against the exchange if a rival company was admitted to the floor. The contract made with the Gold and Stock Company expired about two years ago, and has never been formally renewed. It has been allowed to continue in force indefinitely by the tacit consent of both parties to it. The receipt of a letter threatening legal proceedings against the exchange, excited a great deal of indignation among the governors, and the discussion became long and heated. The result was the adoption of a resolution directing the secretary to send notice to the Gold and Stock Telegraph Company that the contract would be terminated at the end of the month, and that the terms on which the company would be allowed to occupy the exchange after that time would be a matter of agreement from month to month.

THE POSTMASTER AND THE PRIVATE POSTS.—It has been reported that Postmaster Pearson, of this city, was a stockholder in some of the companies for the private delivery of letters, and for that reason had neglected to report to the department the existence of companies that were violating the law. When he was told of this rumor, Mr. Pearson said: "I have never held any stock, nor bought any, nor had any purchased for me, in any messenger or delivery company. The rumor may have arisen from one fact. About a year ago two friends in whom I had confidence came to my office and asked me to sign an application to the secretary of the state for the incorporation of the Manhattan District Telegraph Company. I did so, and my name may therefore have appeared as a corporator, and I am informed, also appeared as trustee for the first year. But I never received notice of my election as trustee, never knew of or attended any meeting, and don't know now where the office of the company is. I was never in any way interested in any other company for the delivery of letters." The district telegraph companies have always held that they act only as special messengers and are not liable to the penalties against private letter-dispatch offices. The section under which companies have been sued for the recovery of penalties expressly excepts from its provisions the carrying of letters by special messengers.

THE GREAT AMERICAN ABSORBER.—It is said that the Western Union has begun a complete absorption of the Mutual Union, for the purpose of saving expenses and concentrating its business. It is reported that the offices of the Mutual Union at No. 135 Broadway are to be vacated on the 1st of July, though an ordinary receiving office of the Western Union may be stationed there. Since the 21st all independent business has been declined there, such messages as were received being transmitted over a short line to the Western Union building, and from there forwarded to their destinations. Nearly all the Mutual Union wires have been transferred to the Western Union building, and are operated there as a part of its own system. Sixty day operators and about fifteen night operators have been employed at No. 135. They have been notified that their services were not wanted after the first of the present month. Most of them have been offered positions in the Western Union Service, but at greatly reduced salaries. Some have declined, others are considering the proposal, and many have accepted and are already at work. Some of them are operating the Mutual Union wires which have been transferred to the building, and in this way, it is said, the management keep up a nominal distinction between the lines of the two companies. It is believed that the Western Union will absorb the Mutual utterly, exactly as it absorbed the Atlantic and Pacific and the American Union companies in the past.

THE TELEPHONE.

NORRISTOWN, Pa., will shortly be connected with Philadelphia by telephone.

POLES.—Over 10,000 telephone poles have been shipped from Murfreesboro, Tenn., and contracts are out for as many more.

THE TELEPHONE CONVENTION.—Telephone men must not forget that the convention of the National Telephone Association takes place at Cincinnati, O., on Tuesday, October 16 next.

GROWTH OF THE BUSINESS IN HARTFORD.—The Hartford, Ct., exchange now has nearly 1,000 instruments connected, and has moved into commodious new quarters, with improved apparatus and a large force.

THE MEXICAN COMPANY.—The Mexican telephone people are still questioning how to raise that $50,000 to pay off the debts and put the company on its feet, and the report of the committee will be awaited with much interest.

THE TELEPHONE FOR THE LIFE-SAVING SERVICE.—The question of connecting the different life-saving stations on Lake Michigan by telephone is being urged upon the Board at Washington. If the desired connection is made the work of the service will be greatly facilitated.

PRESIDENT ARTHUR'S ANTIPATHY TO THE TELEPHONE.—A dispatch from Washington on the 20th says the President spent the day at the Soldiers' Home. He was particularly anxious to escape from the Congressmen who infest Washington this summer in unusual numbers. He expressed annoyance because the Home was connected to the White House by telephone.

DAMAGES FROM A TELEPHONE COMPANY.—Frank Harnett, of Indianapolis, while in the employ of the Central Telephone Company, was seriously injured near Cambridge City, Ind., while unloading telegraph poles. He brought suit against the company for $10,000. The trial has just been concluded in the Federal Court. The jury, after a short consultation, returned a verdict in favor of plaintiff, assessing his damages at $4,800.

PORTLAND, ME.—A correspondent from this point says : The new switch system recently introduced by the telephone exchange here does not appear to give the satisfaction to subscribers which was promised. It is the opinion of many that the incompetence of the employés and not the inefficiency of the switch system is responsible for the dissatisfaction. The salaries paid are too low to secure proper service, a trouble that seems to be much too common in telephonic exchanges.

TELEPHONIC APPOINTMENTS IN TEXAS.—Three division superintendents have been appointed by the new Southwestern Company, operating as follows : T. W. Milburn, of Galveston, has Southern Texas, with headquarters at San Antonio. D. M. Clower, telephone manager at Dallas, has the superintendency of North Texas, including all north of Waco from El Paso to Marshall, with headquarters at Dallas; and Mr. Baker, of Little Rock, has the cities of Marshall and Jefferson and Western Arkansas.

THE LOWELL COMPANIES.—The National Bell Telephone Company of Maine transmitted 1,751 ex-territorial messages during the month of May, an increase of sixty-three over any previous month ; the Boston and Northern transmitted 13,342, an increase of 1,034 over any previous month; the Bay State transmitted 8,698 an increase of 338 ; the Union Telegraph and Telephone Company transmitted 1,469, an increase of 294. A paragraph going the rounds of the press, and probably a month or so old, states that the largest number of telephone subscribers in any single exchange under the Lowell management is at Lowell, where there are 980. Salem is second, with 879 ; Worcester comes next with 871, then Portland with 816, Minneapolis with 780, Lewiston, Me., with 661, Springfield with 635, and Haverhill with 554.

TROUBLE IN OSHKOSH.—Mr. Haskins, of Milwaukee, president of the Wisconsin Telephone Company, was in Oshkosh, Wis., last week, conferring with his attorneys and Mayor Pratt in reference to the ordinance passed by the council instructing the mayor and chief of police to cut down the poles of the Wisconsin Telephone Company should the company refuse to pay $300 into the city treasury as a license. The company has refused to pay the amount, and notified subscribers that it will withdraw all service from the city if the ordinance is enforced. At the same time notice has been served on the chief of police by the company, holding him personally responsible for all costs and damage should he attempt to carry out the provisions of the ordinance.

TELEPHONE CONSOLIDATION.—The Northwestern, Southwestern and Erie telephone systems, recently acquired by the Lowell syndicate, have been consolidated into one system with a capital of $5,000,000. The new company will be called the Erie Telegraph and Telephone Company, and it is formed under the laws of the State of New York. The capital, $5,000,000, is divided into 50,000 shares of a par value of $100 each, of which the Erie Company will represent 15,000 shares, the Northwestern Telephone Exchange Company 13,000 shares, and the Southwestern 20,000 shares, leaving a balance in the treasury of 2,000 shares unissued. Under the consolidation it is believed that a quarterly dividend of 1¼ per cent. will be paid from July 1, and that the stock of each company will appreciate in value.

BROOKLYN'S TELEPHONES.—The Brooklyn *Union* felicitates itself on a newly acquired telegraph wire and the use of two telephone lines, one being that of the Bell Telephone Company, and the other a direct line to police headquarters, where connection is made with the wires to the several station houses, and the city and county departments. It says : The telegraphic and telephonic wires of the police department are kept in excellent order by Mr.

Geo. H. Flanley, the superintendent of that branch of police business, and as he has the fullest support and confidence of Commissioner Jourdan, and is a thorough electrician, and a man of tireless energy, the result is that Brooklyn is as well served in that respect as any city can be. The Bell telephone lines are also a great aid to the getting of late news, and when some means is devised whereby the fouling of lines and the results of induction can be prevented, and employés can be secured who will be good-natured, obliging and entirely attentive to business, the telephoning of news will be even more perfect than telegraphing it now is.

AN UNREMUNERATIVE EXCHANGE.—Mr. George N. Stone, manager of the Cincinnati Telephone Company, refers to the Lawrenceburg, Ind., exchange as an illustration of the proverb that "all is not gold that glitters." The exchange has but thirty-seven subscribers, where there ought to be two hundred and fifty. Mr. Stone says: "The expenses for keeping up that exchange for May were as follows: Royalty on microphones and telephones, $64.75; inspector's salary, $60; regular operator, $25; extra operator, $10; rent of exchange, $10; light and fuel, $10; maintenance of batteries, $13.50; transportation for inspector, $10; add six per cent. on $6.000, cost of construction, $30; total expenses, $233.25; receipts from rentals, $127—a net loss to the company of $106.25. This does not include my expenses in running down there occasionally to see to the management. I am seriously considering the propriety of abandoning the exchange down there, unless the citizens take some interest in making the enterprise self-sustaining." It is proper to add that the Lawrenceburg exchange is exceptional in this respect.

THE MEMPHIS TELEPHONE COMPANY CHANGES HANDS.—The Memphis Telephone and Electric Company has disposed of its property in that city to Messrs. George L. Beetle, of Chicago; E. L. Babcock, Jr., of Evansville; Paul J. Marrs, of Nashville, and their associates. The amount paid is stated to be about $100,000. Messrs. S. T. Carnes, president, and T. H. Milburn, D. J. Milburn, K. C. Neely, Louis Hanover, and Jacob Thompson, directors, resigned their positions, and at a meeting of the new company Mr. E. L. Babcock, Jr., was elected president; Mr. Paul J. Marrs vice-president; and Mr. Baker, of Nashville, secretary and treasurer, who, together with Messrs. E. M. Barton and M. G. Kellogg, of Chicago, compose the new directory. It is the intention of the new company to at once commence building several extra-territorial lines connecting the towns and cities adjoining Memphis. It has, in fact, already contracted for such a line between Memphis and Jackson, Tenn. The new company is also largely interested in the Louisiana Telephone Company and in the Cumberland Telephone Company, of which Mr. Babcock is the president and Capt. Marrs the general manager.

THE SOUTHERN TELEPHONE CO.—It has already been stated in THE ELECTRICAL WORLD that gentlemen from Evansville, Indiana, Nashville, Tenn., Boston and Chicago have secured the States of Louisiana and Mississippi, and have organized the Southern Telephone Company, with a capital stock paid in of $2,000,000, and an authorized capital of $10,000,000. The territory named was hotly contested for by the Lowell companies, but the Evansville parties secured an option on the New Orleans exchange several months ago and thereby procured the property. There are thirteen exchanges in the two States, having at present 1,700 subscribers, 800 of which are in the city of New Orleans. The thirteen exchanges are located in New Orleans, Vicksburg, Natchez, Greenville, Meridian, Columbus, Shreveport, Yazoo City, Baton Rouge, Grenada, Monroe, Holly Springs and Bayou Sara. The directors of the company are as follows: Theo. N. Vail, general manager of the American Bell Telephone Company, of Boston, Mass.; R. S. Boyd, superintendent and inspector for the American Bell Company for the States of Indiana, Illinois and Kentucky; George L. Philips, western manager of the American Bell Company, Chicago. These three gentlemen represent the interest of the American Bell. The other directors are L. C. Huck, of New Orleans, who was the secretary of the original New Orleans company; Mr. M. G. Kellogg, of Chicago; J. T. Rhea, P. J. Marrs, E. T. Baker, of Nashville, and E. S. Babcock, Jr., of Evansville. Mr. E. S. Babcock, Jr., was elected president; Paul J. Marrs, vice-president, and E. T. Baker secretary. It is the intention of the new company to thoroughly rebuild and remodel all its exchanges, and develop the two States in the same manner as Evansville and its vicinity has been developed, and bring it all up to the standard of the Evansville and Nashville exchanges. New Orleans has a population of 216,000, and if developed as Evansville has been should have 3,600 telephones in use. Mr. E. T. Baker, who has been the superintendent of the Evansville exchange, takes charge of the Nashville exchange. Mr. Marrs, who has made such a phenomenal success of the Nashville exchange, goes to New Orleans to take charge there, and Mr. Babcock will spend the fall and winter in New Orleans.

THE ELECTRIC LIGHT.

MR. CHARLES E. BRUSH, the Cleveland inventor of the electric light, is reported to be worth a million and a half.

A TEN-MILE BEACON—The electric light on the tower of the Grand Union, Saratoga, can be seen a distance of ten miles.

THE UNITED STATES ELECTRIC LIGHTING COMPANY has opened a western office at No. 185 La Salle street, Chicago, with Mr. C. C. Warren in charge.

ILLUMINATING THE ROTHSCHILD CARRIAGE. — Baron Rothschild's carriage has been lighted by electricity. The accumulators are placed under the coachman's seat. The electric lights are inside the usual lamps, and will burn for 100 hours.

ILLUMINATIONS AT THE GREAT BRIDAL RESORT.—Niagara's electrical illuminations are much more extensive this year than last, and well worth a long journey to witness. They not only charm bridal parties, but people who have been married for years.

WACHUSETT ELECTRIC LIGHT COMPANY.—We received an invitation to be present at the opening of this company's new lighting station, on Water street in Fitchburg, Mass., opposite the Fitchburg Steam Engine Company's building, on the evening of the 27th.

ILLUSORY ELECTRIC LIGHTS.—Passengers on the steamships or ferryboats below Governor's Island are treated to an odd optical illusion by the electric lights on the Brooklyn Bridge and at the Battery. Viewed from the boat the arc formed by the bridge lights is continued as accurately as geometry could make it, apparently, by the string of lights along the Battery. The illusion is perfect until the boats come near Governor's Island, when Castle William interrupts the pretty spectacle.

THE BERNSTEIN INCANDESCENT LIGHT.—An exhibition of the new Bernstein incandescent light was made at No. 34 Courtlandt street on the evening of the 21st. Its chief feature is a hollow carbon cylinder instead of the usual carbon filament, by which its owners claim a greater degree of incandescence is obtained, with a less degree of waste. The light is intended to be an intermediary between the arc, or 500-candle light, such as is used to light the streets, and the small 8 to 16 candle light.

A BRUSH-SWAN PROJECT IN WASHINGTON.—It is reported that there is a project on foot for a Brush-Swan electric light company in Washington, to supply illumination both for the streets and for interior uses. The company is being organized by Mr. A. A. Hayes, Jr., of the Brush-Swan Company in New York. The plan is to utilize water-power from the canal, a mile above Georgetown. A 500 horse-power turbine wheel is to be put in there, and the electricity will be conveyed to the city by large wires, and distributed. The machinery will be run in the daytime to charge portable batteries, which can be carried about and used to supply residences by what is known as the independent supply system.

PORTLAND ME. — A correspondent says: "The two electric light companies here still continue to run, but the Arnoux does not seem to progress. It has not as many lights burning now as it had two months ago. The Weston, or United States Company, seems to be daily increasing its business, and within a week will put in another dynamo machine. The company's incandescent lights are too costly to be popular; but its arc light is the best yet seen here. The Edison incandescent light, with storage battery, was tried in the *Daily Press* office here without success. The Edison Light and Power Company will begin operations here some time in September, and then we may expect to see electric lighting done in a business-like manner."

A LINEMAN KILLED BY ELECTRICITY.—John Powey, a German employed by the Kansas City (Mo.) Electric Light Company, was instantly killed about 9 o'clock P. M., on June 20, by receiving a charge of electricity through his body. Mr. Powey was employed as lineman and had been at work for several hours repairing some broken wires upon a high pole and at last completed his job. As he started to descend he put out his right arm to steady himself and took hold of the main wire from the works of the company, not knowing that the current had been turned on. His hand touched a portion of the wire which was not insulated and the unfortunate man received the shock of a force equal to 2,000 volts, killing him instantly. The shock threw him backward, where he caught by his heels among some wires, remaining suspended until relieved by the officers of the company. The officers state that the accident was caused by the non-delivery of a message sent to the works which ordered the superintendent not to turn on the current until specially notified. For an hour or more previous to the accident Powey had been taking hold of the wires to steady himself and of course knew nothing of their being charged.

MISCELLANEOUS NOTES.

INCORPORATED.—The Cleveland Electric Company, of Cleveland, O., capital stock, $100,000.

MATERIAL FOR LIGHTNING RODS.—The lightning-rod conference lately held in England decided that copper is the best materials to use in rods.

NEW CABLE COMPANY.—The American, British and Continental (otherwise the "A. B. C.") Cable Company has been organized by English capitalists, and arrangements have been made to lay two additional cables to connect this country with Europe.

ELECTRICITY FOOLING WITH A CROCODILE.—A curious experiment was lately made at Paris to determine the power of a crocodile's jaw. The animal was fixed upon a table with its upper jaw connected with a dynamometer. An electric shock caused him to give a sudden snap, and 308 pounds were marked on the instrument. It was calculated that the contractile force of the muscle causing the movement was 1,540.—*N. Y. Tribune.*

HOLLOW CURBS FOR ELECTRIC WIRES.—A Boston man suggests that the curbs of sidewalks be made of hollow iron, and telegraph, telephone and electric light wires be placed therein. He thinks that if these wires could be carried through an inclosure such as that suggested, which could be opened without the least trouble at convenient distances, one of the greatest obstacles to the method of burying wires, that is, the tearing up of the streets would be overcome. The plan was patented in England, but the patent has expired, and it is therefore free to all.

THE ELECTRIC RESISTANCE OF GLASS.—*Nature* says that M. Foussereau has lately measured the electric resistance of glass by discharging a condenser from a known battery through a thickness of the glass and observing the time required to raise the potential of the condenser to a given degree. Bohemian glass was found to be from five to twenty times as good a conductor as ordinary glass, while flint glass was from 1,000 to 1,500 times as good an insulator. M. Foussereau found also that annealing the glass increased the resistance in some cases eleven-fold.

DAMAGE SUIT FOR A BULLED MESSAGE.—At Franklin, Pa., on June 14, Geo. W. Darr was non-suited in a case in which he was plaintiff and the American Rapid Telegraph Company was defendant. Mr. Darr claimed some $2,000 damages for an error in a cipher message relating to a transaction in oil, the word "natural" having been transformed by the operators into "national." Judge Taylor decided, first, that the plaintiff was bound by the terms of the message blanks as to unrepeated messages; and second, that the defendant was not liable for any damage of which the defendant had no notice, and which defendant could not anticipate from the face of the message. The case is a test case, and will be carried higher.

JAY GOULD'S NEW BOOK.—The Louisville *Courier-Journal* has set many distinguished people to writing books, furnishing the titles of each from its knowledge of the author's experiences. It says that Major Nickerson's new book will be "One Wife Enough;" Mr. McGeoch, of Chicago, will make a book to show that the word fail is actually in existence; Mr. Vanderbilt's work on coupons is anxiously awaited by the scissors manufactories; R. B. Hayes will write a book on the chicken-coop as a home embellishment; General Schenck wants to get out a second volume on the science of poker; Mrs. Langtry will spare no expense on her "Americans I Have Met;" Senator Logan is writing a thick book on the illusory nature of English grammar; Mr. Gould has in his mind a small work on sheep-shearing.

FROGS.—A Louisville (Ky.) scientist sings the praises of the frog, and incidentally refers to the part the humble batrachian has played in the development of electrical science: "Even in the benighted age in which Galvani lived it had been discovered that frogs' legs were good to eat. He had a pair of them hanging on a copper hook, and occasionally the wind would blow them against an iron railing, and they would jerk convulsively whenever contact was established. Galvani noticed it, and set his wits to find out the cause. Everybody knows the history, although it is a long one, and everybody knows that from that simple occurrence, and through the defunct frog's instrumentality we have the telegraph monopoly, the telephone, with the wires crossed half the time and the other half something the matter with the transmitter, the electric light which doesn't burn on cloudy nights, and many other blessings of life. The world owes all those things to the simple fact that a frog's hind legs are good to eat."

STOCK QUOTATIONS.—Telegraph, telephone and electric light stocks were quoted on Tuesday of last week and Tuesday of this week as follows:

	June 19.	June 26.
American District Telegraph	....	36⅛
American Cable	68¼	67½
Bay State Telephone	132	126
Bell Telephone	271	268
Boston & Northern Telephone	160	....
Edison Electric Light Co	310	....
Granite State Telephone	....	....
Mutual Union Telegraph	19⅛	19⅛
Mexican Telephone	2⅜	2¼
National Bell of Maine	....	....
Northwestern	....	....
Suburban	....	138
Southwestern	....	63¼
Tropical Telephone	....	2¾
U. S. Electric Light	128	....
Western Union Telegraph	87¾	86

ELECTRICAL TORPEDOES IN THE POTOMAC.—Two torpedoes have been taken out of the Potomac river, at Washington, from the channel near the mouth of the branch, by the boatman on the large government dredge which has been dredging the channel. The first one was found about six weeks ago, the other on the 16th. The first was taken to the ordnance machine shop, emptied of the powder, cleaned and examined. The second is made of light boiler-iron, in the shape of a cylinder, about three and a half feet in diameter and about the same in length. It contained about two barrels of coarse gunpowder, which was fortunately wet at the time it was scooped in. The copper-wire attachments to be connected with an electrical battery to explode it are still intact. There are two small holes in the iron, caused by rust. After taking the first one out and discovering that it was full of wet powder, the workmen were very particular about how they handled the second until they were satisfied that the powder in it was also wet. Had either of them been made of copper they would have been thoroughly dry inside, and as the scoop made a large indentation in the sides of them, they might have exploded and blown up the vessel and all on board.

JAY GOULD'S STOCKS AND YACHT.—A story is circulated in Wall street that Jay Gould has been negotiating for the sale of his Western Union stock. When questioned he denied that he was trying to sell any of his telegraphic stock. One of the city papers says: Mr. Gould recently received a bid from persons in England for 50,000 shares of Western Union stock at 80, which he says he refused. He informed the English people that while he did not propose to sell any of his own holdings, if they wanted 50,000 shares of Western Union stock he would get it for them at whatever price he could. Mr. W. E. Connor, referring to the subject, remarked: "Mr. Gould has got his property in just the position he wants it, and I do not believe that there will be a change of 5,000 shares in his holdings of stock between now and the time he starts on his proposed trip." The Atalanta will probably be ready for use in a few weeks, but Mr. Gould does not expect to start on his long voyage until next fall. His yacht will sail under the colors of the new American Yacht Club. "There will probably be months when Mr. Gould will not be able to hear a word regarding the New York stock market," said an intimate friend of the millionaire yachtsman. "I will wager that Jay Gould will not get beyond the reach of telegraphic communication with this market," said Rufus Hatch emphatically.

ELECTRICAL PATENTS ISSUED

And Dated June 19, 1883.

Alarm for printing telegraphs; Stephen D. Field, New York, N. Y.	279,730
District signal and messenger call box; Eugene H. Applegate, Washington, D. C.	279,629
Electric-arc lamp; Henry Ansot, New York, N. Y.	279,517
Electric-circuit cut-out; A. Livingstone Bogart, Jamaica, N. Y.	279,634
Electric-arc lamp; Robert J. Sheehy, New York, N. Y.	279,824
Electrical insulator; Demetrius M. Seward, Cincinnati, Ohio	10,344
Electro-galvanic belt; George E. Palmer, Boston, Mass.	279,881
Galvanic battery; Theodore L. Kauffer and James Serson, Boston, Mass.	279,879
Incandescent lamp; Charles Richter, Camden, N. J.	279,811
Protector for telegraphic and telephonic instruments; M. Daniel Connolly, Philadelphia, Pa. (4 patents).	279,712-3-4-5
Printing telegraph; Stephen D. Field, New York, N. Y. (2 patents)	279,729, 279,865
Printing telegraph; Samuel V. Essick, Alliance, Ohio	279,550
Plug for electrical switch-boards; Edward Flint, Jr., Boston, Mass.	279,557
Secondary electric battery; Eli T. Starr, Philadelphia, Pa.	279,639
Telegraphic repeater; Joseph P. Smithers, Brooklyn, N. Y.	279,670
Telephone switch-board; Everlyn B. Hamlin, Chicago, Ill.	279,747
Underground system of laying electrical conductors; James E. Hamilton, New York, N. Y.	279,64

All Persons Sending for

Catalogues or ordering articles advertised in our columns will do us and our Advertisers both a great favor by mentioning that they saw the advertisement in

The Electrical World.

CAT-HEAD CARDS.—Lovely set, 4 designs. Mailed on receipt of 5c. HEARNE & CO., Box 1487, N. Y.

FAIRMAN, J. F. Everything related to Electricity for sale, and Electrical work done. Inventors' Institute, Cooper Union.

Pride, Fraleigh & Kyle, Telegraph Engineers, Electricians and Contractors, 23 and 25 Dey Street, New York.

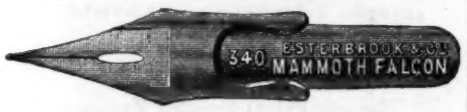
CARDS Send five 3c. stamps for fine new set of IMPORTED CARDS, WHITING, 50 Nassau St., N. Y.

SHORT-HAND WRITING THOROUGHLY taught by mail. Terms low; satisfaction guaranteed. Send stamp for circular and specimen of writing.
W. W. HULTON, Stenographer, Pittsburgh, Pa.

Short-Hand Writing thoroughly taught by mail. Good situations procured all pupils when thoroughly competent. First-class stenographers furnished railroad officials without charge for my services. Correspondence solicited. Caligraphs sold. Special inducements offered operators and railroad officers. Send for COLLEGE REPORTER and caligraph circulars to W. G. CHAFFEE, Oswego, N. Y.

NEW
FOOT LATHES,
For Electricians.
Send stamp for circular to
Narragansett Machine Co.,
23 Butter Exchange,
PROVIDENCE, R. I.

JUST THE PEN FOR OPERATORS.



Esterbrook's Mammoth Falcon No. 340.

LARGE ALL-WOOD PENHOLDERS TO SUIT.

Sample dozen Pens and Holder 40 cents.

THE ESTERBROOK STEEL PEN CO.,
Works, Camden, N. J. 26 John St., N. Y

GEO. H. WHIPPLE,

58 Exchange Place, N. Y.

ELECTRIC LIGHT TELEPHONE, TELEGRAPH
—AND—
Miscellaneous Stocks.

CORNELL UNIVERSITY

COURSES IN
Electrical Engineering,
Mechanical Engineering,
Civil Engineering
and Architecture

Entrance Examinations Begin at 9 A. M., June 18 and Sept. 18, 1883.

For the UNIVERSITY REGISTER, containing full statements regarding requirements for admission, courses of study, degrees, honors, expenses, free scholarships, etc., and for special information, apply to THE PRESIDENT of CORNELL UNIVERSITY, Ithaca, N. Y.

JOHN B. SABINE,

ATTORNEY AND COUNSELOR-AT-LAW, NOTARY PUBLIC
AND
PRACTICAL TELEGRAPHER.
102 Broadway, New York.

Special attention given to the *Law of Telegraphs;* to the incorporation of *Telegraph, Telephone and Electric Light Companies;* to all litigation arising in the construction and maintenance of lines; to the defense in all claims for errors and omissions in the transmission of messages, and for injuries resulting from the use of Electric light and other wires.

Letters patent obtained for all electrical inventions of merit in all countries.

Collections made for manufacturers and others.

Correspondence Solicited.

CHESTER & CO.,
22 New Church St., N. Y.
Formerly C. T. & J. N. Chester, 104 Centre St.

Consulting Engineers and Electricians.

Special attention given to developing inventions and securing patents. Expert advice given: every class of electro mechanical construction attended to, and all classes of electric supplies furnished. P. O. Box 2766.

ENGLISH
Patent Office.
H. GARDNER,
166 Fleet St., London.
Successor to
Messrs. Robertson, Brooman & Co.

Gives prompt personal attention, and obtains Patents for Inventions. Protection for Trade Marks, etc., at fixed and moderate charges. Pamphlet of costs gratis.

Thirty years' practical experience.

Provisional Protection, £8'

Gelatinized Fibre.
(Trade Mark.)
The New Substitute for Hard Rubber.

Adopted by the leading Electric Light Companies and Manufacturers of Electrical Apparatus, being a better non-conductor, lighter and more durable, at half the cost.

Send for samples, circulars and prices to
COURTENAY & TRULL,
No. 15 Dey St., New York.

CEDAR TELEGRAPH POLES.

LIGHT POLES FOR TELEPHONE LINES AND LONG POLES FOR CITY USE CONSTANTLY ON HAND.

50,000 Split Cedar Posts on Hand Ready for Immediate Delivery.

BROWNLEE & CO.,
Detroit, Mich.

PINS AND BRACKETS.

We are now prepared to furnish
Pins, Plain, at $10 per thousand.
Pins, Painted, $11 per thousand
Brackets Plain, $13 per thousand.
Brackets, Painted, $15 per thousand.

BEST QUALITY OF OAK.

SPECIAL REDUCTION ON LARGE ORDERS.

L. B. HARRIS,
Manchester, N. H.

THE CARBONS

MANUFACTURED BY THE
American Carbon Co.,
ST. LOUIS, MO.,
Are Warranted the Best
FOR ELECTRIC LIGHTS.
L. G. TILLOTSON & CO.,
AGENTS,
5 and 7 Dey Street, N Y.

DELANO, HAINES & CO.,
BROKERS, PROMOTERS
AND
General Commission Merchants.
NEW YORK AND MEXICO.

The Organization of Companies and the Development of Electrical Enterprises of merit a specialty.

NEW YORK CITY.

F. M. DELANO, J. D. HAINES, } Temple Court, 5 Beekman Street.

MEXICO CITY.

G. W. LA RUE, G. L. WILEY, } Primera Calle de San Francisco, 5.

EXECUTIVE OFFICERS OF
"The Mexican Telephone Company,"

J. D. HAINES, Treasurer. **F. M. DELANO,** President.

DAY'S
KERITE INSULATED
Telegraph, Telephone and Electric Light
WIRES AND CABLES,

MANUFACTURED ONLY BY THE INVENTOR,

AUSTIN GOODYEAR DAY,

OFFICE: 120 BROADWAY, NEW YORK.

FACTORY: SEYMOUR, CONN.

KERITE INSULATION should be used on electrical conductors for any of the following purposes:

Submarine, Underground or Aerial Telegraph, Telephone and Electric Light Cables; Office Cables and Lines; also for Battery, Burglar Alarm, Fire Alarm, Police and Submarine Blasting Purposes,

or for any other operation which requires perfect, indestructible and permanent insulation of electric wires.

A large number of

ANTI-INDUCTION KERITE TELEPHONE CABLES,

some of them TWO MILES IN LENGTH, are in use in several cities, and are found to WORK PERFECTLY for that distance.

Kerite is recommended and indorsed by all leading men connected with telegraphy, telephony, and electric lighting.

At the CENTENNIAL EXHIBITION at Philadelphia, Sir WILLIAM THOMSON, the eminent Electrician and Scientist, awarded to the

Kerite Insulated Wire and Cables
A DIPLOMA

For "Excellence of the Insulation and Durability of the Insulator."

For Sale by all Dealers in Telegraphic Materials.

CLARK B. HOTCHKISS, Gen. Agt.
120 Broadway, New York.

Cheapest and Best Book of its Class Published.
A $5 Book for $2.50! Embodies the Leading Details in 200 Trades!
Moore's Universal Assistant and Complete Mechanic

Contains over 1,000,000 Industrial Facts, Processes, Calculations, Legal Items, Business Forms, Rules, etc., of paramount utility to every Manufacturer, Mechanic, Farmer, and Business Man. Gives full details about Lumbering, Sawmills, Planing Mills, Saw-filing, Speed of Wheels, Pulleys, Drums, Circular Saws, Wood-working Machinery, etc. On Mill-dams, Water-wheels, Horse-power of Streams, Power of Steam, Wind, etc.; Tensile, Torsional, and Crushing Strength of Materials; Seasoning of Timber (12 ways), Logging, Cost of Supplies, Stream-driving, Lumber Measurement and Surveyors' Tables, full and complete. Details for Cotton, Woollen, and Fulling Mill Machinery; do. for Flour, Oatmeal, Shingle, Paper, and Wind Mills, Grain Elevators, Sugar, Oil, Marble, and Rolling Mills, Blast Furnaces, Gas-works, Water-works, Hydraulics, etc. The work contains 500 ENGRAVINGS, 461 TABLES, containing over 500,000 Calculations; full details for Constructing, Operating, and Repairing Mill and Steam Machinery of every kind. New process Milling, Balancing Mill-stones, Setting of Valves, Link and Valve Motion, Eccentrics, Indicator Diagrams, Injectors, Steam Boilers, Gauges, Machinists' Tools, Mechanical Movements, Tunnelling, Mining, and Rock-drilling Machinery; Plans of Mills, Bridges, etc. Instructions to ENGINEERS, FIREMEN, BOILER-MAKERS, ENGINE AND CAR BUILDERS; Proportion of Engines, Boiler and Steam-pipe Covering, Scale Preventives (10 kinds), Cements (69 kinds), Steam-packing, Bright Polish (4 kinds). Details for Locomotive and Railroad Car Construction; to Repair Locomotive Break-downs on the Road; details in immense variety for Gas, Steam, Civil, and Mining Engineers, Machinists, Blacksmiths, Iron-founders, Miners, Metallurgists, Assayers, Plumbers, Gas-fitters, Tinmen, Coppersmiths, Builders, Metal and Wood Workers of every trade. Alloys for all purposes (418 kinds). On Prospecting, Mining, Processes of Gold and Silver Extraction, Refining, etc. On Lathe-gearing, Screw-cutting, Gear-cutting, Gearing Compound Lathe, Turning, Boring, Filing, Finishing, Bevel-gears, Shafting, Belting, Friction, Tool-making, Tempering, Annealing, Toughening and Tempering of Steel, Tempering Liquids, Metallic Tempering Baths, Welding Compounds, Case-hardening, etc., U. S. Government $10,000 Tempering Secret. To make Cutting, Drilling, and Boring Tools, Screws, Taps, Files, Emery Wheels, Reamers, Cold Chisels, Safes, Springs of all kinds, Mill-picks, Stone-cutters' Tools, Cutlery, Dental and Surgical Instruments, etc. Items for Iron, Brass, Bronze, Type, Stereotype, and Bell Founders, Pattern-makers, etc. Diam., Cir., and Areas of Circles, Pitch of Wheels, Specific Gravities, Expansion of Metals, Smelting of Metals, Reducing of Oxides, Making of Crucibles, Weight of Metals, Capacities of Tanks, Cisterns, Boilers, Weight of Water, Heating of Buildings, Jointing of Pipes, etc. To Compute Power of Steam Boilers. Bronze Dips, Lacquers, Japans, etc. (93 kinds). Carpentry, Diagrams of Roofs, Tonnage Tables, Stowage in Ships, Modelling of Vessels, Ship-building, Navigation, Solid Contents of Boxes, Bales, Stones, Barrels, Timber, Freights by Rail and Water, Tonnage Rules, Estimates, Tables, etc., for Masons, Bricklayers, Plasterers, Roofers, Stucco Workers. On Art work, Decoration, Painting, Sign Writing, Frame Gilding, Wood Staining, Varnishing, Polishing, Glass Signs, etc., (600 Items). Glass Staining and Gilding, Photography, Restoring Old Paintings, etc. 500 Items for Watchmakers, Jewellers, Gilders; 800 Items for Printers, Authors, and Publishers; 400 Health Items. Details for Merchants on Banking, Bookkeeping, Advertising, Safe Business Rules, etc.; Exchange Tables, Ready Reckoner, Interest, Coal, and Tonnage Tables, Standard and Metric Systems of Weights and Measures, Sterling Tables, Rules for Computing Profits, Percentages, etc.; 400 Receipts for Grocers, Confectioners, etc.; 300 Receipts for Dyers, Bleachers, Hatters, Paper Manufacturers, Pulp Colors, etc.; 400 for Trappers, Tanners, Curriers, Boot, Shoe and Harness Makers; 10,000 Trade Secrets and Scientific Facts. Thousands of details for Farmers: Land, Grain, Hay, and Cattle Measurements, Contents of Granaries, Corn-cribs, etc.; Fencing, Ploughing, Planting, Seed, and Breeding Tables, Food and Manure Values, 16 Fertilizers, Horse and Cattle Remedies, all kinds. To Break, Train, and Shoe Horses, Rotation of Crops, to Kill Farm Pests; Rural Economy, Soiling of Stock, Bee-keeping, Construction of Hives, Plans of Barns, Butter and Cheese Making, etc. Business Forms, all kinds. Legal Items, Special Laws of 49 States, Territories, and Provinces (in the U. S. and Canada) relating to the Collection of Debts, Exemptions from Forced Sale, Mechanics' Lien, the Jurisdiction of Courts, Transfer of Real Estate, Rights of Married Women, Interest and Usury Laws, Limitation of Actions, etc.

"Is a reference library in itself."—*Amer. Grocer.* "An ample study for a whole winter."—*Maryland Farmer.* "Forms complete treatises on the various subjects."—*Sci. Am.* "This may be called a book of wonders, for it has a compilation of information from all avenues of knowledge. No where else can such a mine of intellectual wealth be found; it should be in every household; certainly in every office and workshop."—*Kan. City Times.* "There have been many attempts to put a library into one volume, and certainly no previous attempt has been so successful as this one."—*The Methodist.* "A regular condensed UNIVERSAL ENCYCLOPEDIA."—*Mfr. and Bldr.* "The ASSISTANT is the most complete and valuable of any work of its kind we have ever seen."—*Am. Machinist.*

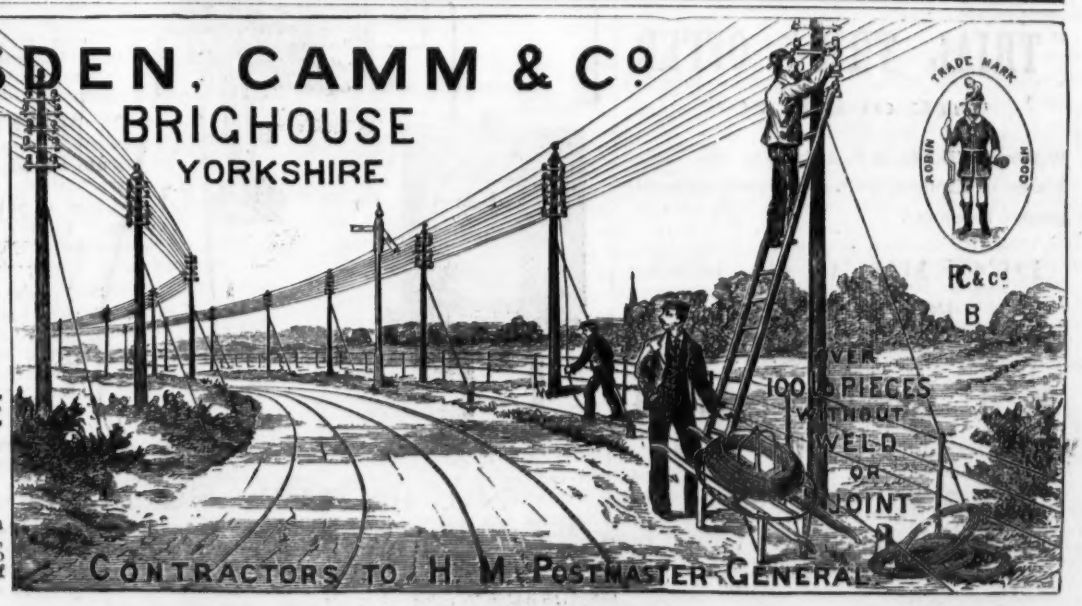
Counting cost of production, the ASSISTANT is the cheapest work of its class published. It contains 1016 pages, is a marvellous repertory of valuable information, and worth its weight in gold to any Mechanic, Farmer, or Business Man. 1 vol. 12mo. Free by mail to any address, in best English cloth, for **$2.50**; in leather, library style, lettered back and marbled edges, for **$3.50**. Address all orders to

W. J. JOHNSTON, Publisher,
No. 9 Murray Street, New York.

RAMSDEN, CAMM & Co.
BRIGHOUSE
YORKSHIRE

MANUFACTURERS OF
PATENT
Telegraph Wire
To Government Specifications.
BEST REFINED
Telephone Wire,
FENCING WIRE,
SUBMARINE CABLE WIRE
Strand & Stay Wire,
AND
Galvanized Binding Wire.

Correspondence solicited from American Telegraph, Telephone, Railway and other companies, also contractors, etc., using quantities of wire.



THE

ELECTRICAL WORLD,

AN ILLUSTRATED WEEKLY REVIEW

of Current Progress in Electricity and its Practical Applications.

TERMS OF SUBSCRIPTION,

Invariably in advance:

One Copy, 1 year, Postage Prepaid, $2.00.

Six Months, $1.00;

Three Months, 50c.

Clubs of 5 or more yearly subscriptions

$1.50 each.

A Copy for a year FREE to the getter-up of a club of 10 at the special $1.50 rate.

SPECIAL OFFER.

THE ELECTRICAL WORLD

will be mailed to any address in the United States or Canada from the present time until December 29, 1883,

FOR $1.00.

No one who desires to keep abreast of the wonderful activity in Electrical Discovery and Invention that characterizes our time should be without it.

The Postage to any part of the United States or the Dominion of Canada is always prepaid by the publisher, and addresses are changed as often as desired, without extra expense.

To foreign countries in the Universal Postal Union—which includes Newfoundland, England, France, Germany, Australia, etc.—the subscription price, postage prepaid, is $3.00 per annum.

Remit by post office order, draft, registered letter or express. U. S. postage stamps taken. Address communications and make orders payable to

W. J. JOHNSTON, Publisher,

No. 9 MURRAY ST., NEW YORK.

THE OPERATOR

A JOURNAL OF

Telegraphic Literature, News and Miscellaneous Reading.

PUBLISHED ON

THE 1st AND 15th OF EACH MONTH.

SUBSCRIPTION, IN ADVANCE,

ONE DOLLAR A YEAR.

Postage Prepaid to any part of the United States or Canada.

To Foreign Countries the Subscription, POSTAGE PREPAID, is $1.50 a Year.

SPECIAL

"TRIAL TRIP" OFFER.

THE OPERATOR

Will be mailed to any address in the United States or Canada, postage prepaid, from the present time until

DECEMBER 15, 1883,

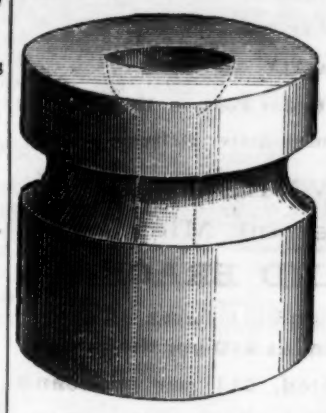
FOR 50 CENTS.

W. J. JOHNSTON, PUBLISHER,

9 MURRAY ST.,

NEW YORK.

Hard Porcelain Insulators,



LARGE AND SMALL,

FOR

Telegraph, Telephone

AND

Electric Work.

UNION PORCELAIN WORKS,

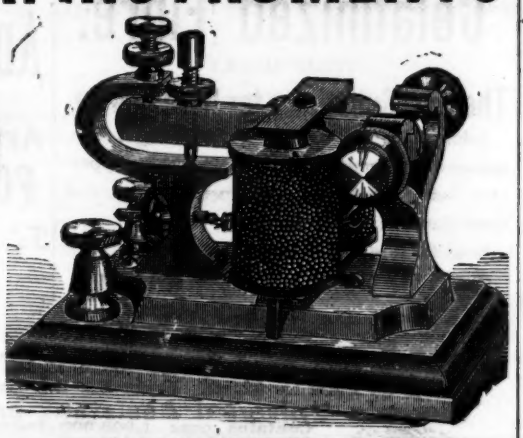
300 Eckford Street,

GREENPOINT, N. Y.

LYMAN'S O. K. INSTRUMENTS

No 2 O. K. KEY

The above Key is a perfect working key, and has *pure platinum points.* Price, $1.45, C. O. D., subject to inspection.



No. 2 O. K. SOUNDER.

The above Sounder is warranted to work well where any sounder will. Price, $2.60, C. O. D., with privilege to examine before paying for it.

The above Sounder and Key (either on one base or separate, as ordered), one full-sized Callaud battery, 1 lb. vitriol, 15 ft. office wire, etc., all nicely packed and sent C. O. D., **$4.50,** with privilege to examine before paying for them.

These instruments are neat in appearance, strong and durable. The bases of the key and sounder are iron, japanned, and nicely ornamented with gold leaf. The levers are iron, bronzed, and look as well as brass. All the screws, check-nuts, binding-posts, etc., are of brass, nicely finished. The contact points in the key are *pure platinum.* The sounder magnets are full size, and wound to work on a line from a few feet to 10 miles without relay.

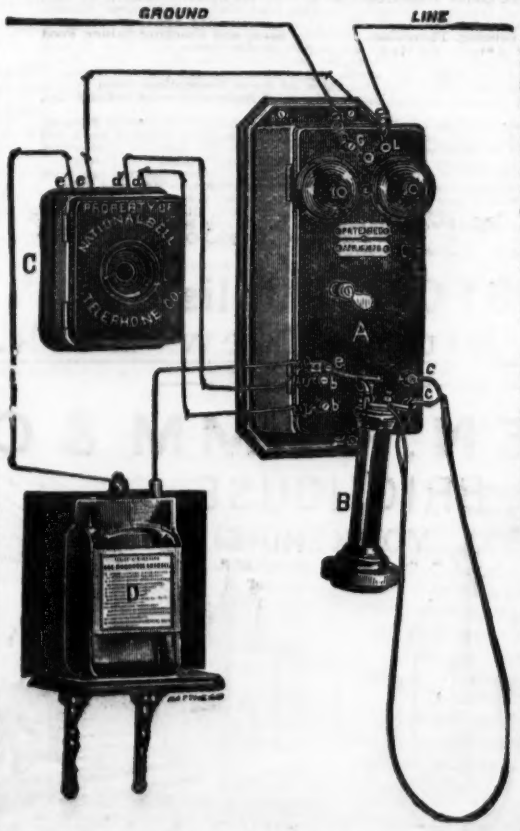
If you want cheaper instruments, send for my reduced price list, which I mail free of charge. Will fill all orders the same day I receive them. Address, mentioning THE OPERATOR,

A. B. LYMAN & CO.,

39 SOUTH WATER STREET, - - CLEVELAND, O.

THE AMERICAN BELL TELEPHONE COMPANY.

W. H FORBES, President. W. R. DRIVER, Treasurer. THEO. N. VAIL, General Manager.



This Company, owning the Original Patents of Alexander Graham Bell for the Electric Speaking Telephone, and other patents covering improvements upon the same, and controlling, except for certain limited territory, under an arrangement with the Western Union Telegraph Company, the Gold and Stock Telegraph Company, the American Speaking Telephone Company, and the Harmonic Telegraph Company, the patents owned by those companies, is now prepared to furnish, upon application, either directly or through any of its agents, Telephones of different styles, and applicable to a variety of uses.

This company desires to arrange with persons of responsibility for establishing

District or Exchange Systems,

in all unoccupied territory, similar to those now in operation in all the principal cities in this country.

Responsible and energetic persons are required to act as licensees for the purpose of establishing

PRIVATE LINE AND CLUB LINE

systems, for business or social uses. Also to introduce the telephone for

SPEAKING TUBE

purposes, for which instruments will be leased for a term of years at a nominal rental.

This Company will arrange for telephone lines between cities and towns where Exchange systems already exist, in order to afford facilities for personal communication between subscribers or customers of such systems.

We respectfully invite attention to this matter, and any further information relating thereto can be obtained from the Company,

No. 95 Milk Street, Boston, Mass.

All persons using Telephones not licensed by this Company are hereby respectfully notified that they are liable to prosecution, and for damages for infringement, and will be prosecuted accordingly to the full extent of the law.

PALMER WIRE CO.,

PALMER, MASS.

TELEGRAPH

AND

TELEPHONE

WIRE,

As Good as the best. Special care taken in its manufacture.

Write us for prices before ordering elsewhere.

W. T. HENLEY'S

TELEGRAPH WORKS COMPANY

(LIMITED),

Telegraph Engineers and Contractors Wire Drawers and Galvanizers.

MANUFACTURERS OF

Submarine, Subterranean and Aerial Cables of every description, for Telegraph, Telephone and Electric Light Purposes.

Henley's Patent Ozokerited Core,

Henley's Patent Dynamo Machines and Electric Lamps.

Estimates for any kind of cables or core furnished. OFFICE:

8 Draper's Gardens, Throgmorton Street,

LONDON, ENGLAND.

WORKS: North Woolwich.

AGENTS IN THE UNITED STATES,

Western Electric Co., New York, Chicago.

CHARLES WILLIAMS, JR.

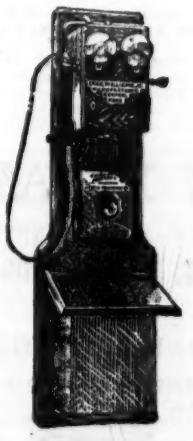
(ESTABLISHED IN 1856),

109 Court Street, Boston, Mass.,

AUTHORIZED MANUFACTURER OF

THE AMERICAN

BELL TELEPHONE CO.



Magneto, Crank and Push Button Call Bells, Electric Bells, District Bells and Switches for Exchanges. Annunciators, etc.

Telegraph and Electrical Instruments, Batteries, Wire, Insulators, and Telephone Supplies of every Description.

GENERAL TREATISES.

WONDERS OF ELECTRICITY. Translated from the French of J. BAILE. Edited, with Numerous Additions, by Dr. JOHN W. ARMSTRONG. 12mo, cloth, 65 illustrations. New York, 1872. $1.25.

CONTENTS.

Introduction—Electric Telegraph—Induction Machine—Electric Light—Electro-Plating—Appendix.

This interesting book reviews in a popular way the history, the phenomena and the applications of electricity. To the layman who desires to acquire general information regarding the capabilities of the science, this book will commend itself readily by the simplicity and lucidity of its descriptions, and the interesting, narrative way of presenting the topics. There are two appendices, the work of the translator, which are of evident value. The first of these relegates to American genius the credit of that invention known as the Ruhmkorff coil, and constitutes a very able and complete review of the labors of Prof. Page and others in this field.

ELECTRICAL TABLES AND FORMULÆ FOR THE USE OF TELEGRAPH INSPECTORS AND OPERATORS. Compiled by LATIMER CLARK and ROBERT SABINE. 12mo, cloth. London, 1871. $5.00.

This is an immense aggregation of isolated facts, figures and formulæ, collated in such form as to be available for ready reference. Definitions are given of the various electrical units, and the laws of electricity, magnetism and electro-magnetism are clearly stated. The different methods of localizing faults in aërial and submarine lines are also described. Convenient recipes and tables of every sort and size complete the book.

CANDLE-POWER OF THE ELECTRIC LIGHT. By PAGET HIGGS, LL.D., D.Sc. Crown 8vo, paper. 25c.

CONTENTS.

Comparison of Various Arc Lights—Comparison of Various Incandescent Lights—Economical Ratio of these Systems of Lighting—Relation of Lighting Power to Quantity of Current—Sources of Loss in Existing Lamps.

The determination of the candle-power of the electric light is a matter of much importance in its bearing upon the question of the comparative economy of electricity and gas as means of illumination. Its importance is illustrated by the fact that the publishers deemed this little pamphlet of thirteen pages to be worth seventy-five cents. The sale of the book was so much larger than expected that the price has recently been reduced to twenty-five cents.

ELEMENTS OF CONSTRUCTION FOR ELECTRO-MAGNETS. By COUNT TH. DU MONCEL. Translated from the French by C. J. WHARTON. 8vo, cloth, illustrated. London 1883.

CONTENTS.

Introduction—Formulas for Electro-Magnets—Conditions of Maximums for Electro-Magnets on a Simple Circuit—Conditions of Maximum on Compound Circuits—Application of the Laws of Maximum to the Construction of Electro-Magnets—Numerical Examples of the Application of the Preceding Formulas—Experimental Verification of the Laws of Electro-Magnets—Effects of a More or Less Complete Magnetic Saturation—Condition for the Good Construction of Electro-Magnets—On the Best Grouping of the Cells of a Battery.

This is a work on a timely subject, which has just been published. It is the only book which treats of the construction of electro-magnets, a matter which has an important bearing upon the efficient working of telegraph lines, dynamo-electric machines, and other applications of electricity and magnetism.

ELECTRO-MAGNETS: The Determination of the Elements of their Construction. By TH. DU MONCEL. Translated from the Second Edition. 18mo, boards. New York, 1883. 50c.

This is practically the same as the last mentioned work, but is a cheaper, American edition.

THE GALVANOMETER AND ITS USES. A Manual for Electricians and Students. By C. H. HASKINS. Second Edition, Revised. 12mo, morocco, 8 illustrations. New York, 1881. $1.50.

CONTENTS.

Explanatory Chapter—Various Forms of the Galvanometer—Formulæ and Tables.

As electrical science advances and our telegraphs increase, the importance of a knowledge of the use of the galvanometer becomes greater every day. Only he who has used the galvanometer can fully appreciate the value of Mr. Haskins' handbook. It is small, condensed, complete, and as full of information about galvanometers and their uses as an egg is of meat.

REPORTS OF THE COMMITTEE ON ELECTRICAL STANDARDS APPOINTED BY THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Revised by Sir W. THOMSON, Dr. J. P. JOULE, Professors J. CLERK MAXWELL and F. JENKIN. With a Report to the Royal Society on Units of Electrical Resistance, by Prof. F. Jenkin; and the Cantor Lectures, Delivered by Prof. Jenkin before the Royal Society of Arts. Edited by Prof. Fleeming Jenkin, F.R.S. 8vo, cloth. London, 1873. $3.75.

The nature of the contents of this volume is fully expressed in the title, given above. The work is illustrated by numerous diagrams and plates. The advanced electrician will here find detailed the methods by which the British Association units of electrical measurement, now used all over the world, were determined. The Cantor Lectures of Prof. Jenkin, which are appended, give a comprehensive scientific account of submarine telegraphy, and the methods of testing ocean cables.

A TREATISE ON ELECTRICITY AND MAGNETISM. By JAMES CLERK MAXWELL, F.R.S. Second Edition. In two volumes, 8vo, cloth, 20 plates and 105 illustrations. Oxford, 1881. $8.00.

CONTENTS.

On the Measurement of Quantities—Description of Phenomena—Elementary Mathematical Theory of Electricity—On Electrical Work and Energy in a System of Conductors—General Theorems—Mechanical Action between two Electrical Systems—Points and Lines of Equilibrium—Forms of Equipotential Surfaces and Lines of Flow—Simple Cases of Electrification—Spherical Harmonics—Confocal Surfaces of the Second Degree—Theory of Electric Images—Conjugate Functions in two Dimensions—Electrostatic Instruments—The Electric Current—Conduction and Resistance—Electromotive Force between Bodies in Contact—Electrolysis—Electrolytic Polarization—Mathematical Theory of the Distribution of Electric Currents—Conduction in three Dimensions—Resistance and Conductivity in three Dimensions—Conduction through Heterogeneous Media—Conduction in Dielectrics—Measurement of the Electric Resistance of Conductors—Electric Resistance of Substances—Elementary Theory of Magnetism—Magnetic Force and Magnetic Induction—Magnetic Solenoids and Shells—Induced Magnetization—Particular Problems in Magnetic Induction—Weber's Theory of Induced Magnetism—Magnetic Measurements—On Terrestrial Magnetism—Electromagnetic Force—Ampère's Investigation of the Mutual Action of Electric Currents—On the Induction of Electric Currents—On the Induction of a Current on Itself—On the Equations of Motion of a Connected System—Dynamical Theory of Electro-Magnetism—Theory of Electric Currents—Exploration of the Field by Means of the Secondary Circuit—General Equations of the Electro-Magnetic Field—Dimensions of Electric Units—On Energy and Stress in the Electro-Magnetic Field—Current-Sheets—Parallel Currents—Electro-Magnetic Instruments—Electro-Magnetic Observations—Comparison of Coils—Electro-Magnetic Unit of Resistance—Comparison of the Electro-Static with the Electro-Magnetic Units—Electro-Magnetic Theory of Light—Magnetic Action of Light—Ferromagnetism and Diamagnetism Explained by Molecular Currents—Theories of Action at a Distance.

This work is one of the great classics on electricity. It was written as a complement to Faraday's "Experimental Researches," treating the subject from the mathematical point of view, as that work did from the physical. To understand it a thorough mathematical knowledge is essential. To the student of electricity who takes up the study from purely scientific interest, and desires to investigate the subject to the very bottom, Maxwell's great work is indispensable. No one who wishes to truthfully apply to himself the title "Electrician," in its highest sense, should rest until he has mastered this work, even if he should have to take up the study of the higher mathematics for that purpose.

MATHEMATICAL TREATISES.

AN ELEMENTARY TREATISE ON ELECTRICITY. By JAMES CLERK MAXWELL, F.R.S. Edited by WILLIAM GARNETT, M.A. 8vo, cloth, 6 plates and 54 figures in the text. Oxford, 1881. $2.00.

CONTENTS.

Electrification, Electromotive Force, Potential, etc.—On the Charges of Electrified Bodies—On Electrical Work and Energy—The Electric Field—Exploration of the Electric Field—Faraday's Law of Lines of Induction—Particular Cases of Electrification—Electrical Images—Capacity—Electric Current; Metals, Electrolytes, Dielectrics—Phenomena of an Electric Current which flows through Heterogenous Media—Methods of Maintaining an Electric Current—On the Measurement of Electric Resistance—On the Electric Resistance of Substances.

We have placed this work among the mathematical treatises because it contains a greater proportion of formulæ than those above mentioned; but there is very much in it to interest and instruct the non-mathematical reader. This is especially true of its definitions of the technical terms used by advanced electricians, which are so troublesome to the beginner. The work was left incomplete on the death of its distinguished author; fortunately, but little remained to be added, and this has been done in the spirit in which he wrote. The mathematical portion is nearly all confined to one chapter, which may be omitted by those who are not prepared for it.

AN INTRODUCTION TO THE THEORY OF ELECTRICITY. With Numerous Examples. By LINNÆUS CUMMING, M.A. Second Edition, with Corrections and Additions. 8vo, cloth, 100 diagrams. London, 1879. $3.00.

CONTENTS.

Physical Units—Theory of Potential—Application of Potential to Statical Electricity.—Problems in Statical Electricity—Theory of the Voltaic Cell—Ohm's Law—Problems in Voltaic Electricity—Magnetism—Absolute Dimensions of Physical Units—Problems in Magnetism.

The electrician who loves to set practice aside occasionally, in order to dwell on the science for its own sake, and the advanced student who wishes to master thoroughly every governing principle, both ought to have and use this interesting book. There are many students who desire to acquire a mathematical knowledge of the principles involved, in order to be able to reason about them and to analyze their capabilities more fully, and yet who cannot quite grasp the intricate equations of Clerk Maxwell. To such, this book will prove a great boon, because it accomplishes the same objects in another way. The author confines himself to geometrical methods of analysis, as being, in a manner, more tangible and comprehensible; and therein is a great improvement. We can follow this method of analysis more readily and grasp it more securely than by the use of the calculus. But even if it were only to serve as a stepping-stone to the more profound and exhaustive work of Clerk Maxwell, this book ought to prove of the utmost convenience and utility.

DICK'S ENCYCLOPEDIA

OF

PRACTICAL RECEIPTS AND PROCESSES,

CONTAINING 6,422 PRACTICAL RECEIPTS,

Written in a plain and popular manner, and illustrated with explanatory wood-cuts. Being a comprehensive Book of Reference for the Merchant, Manufacturer, Artisan, Amateur and Housekeeper, embracing valuable information in the Arts, Professions, Trades, Manufactures, including Medicine, Pharmacy and Domestic Economy. The scope of this work is entirely different from any other book of the kind. Besides being a complete and almost indispensable book of reference for the thousand and one receipts and articles needed in every household, farm, garden, etc., it includes clear and easily understood directions for the application of many of the Arts usually acquired only by long experience, and so divested of technicalities, or the technical terms used so fully explained, as to bring the entire subject within the comprehension of any person of ordinary intelligence. It would be difficult to find any one of the 6,422 paragraphs in this work (many of which contain several receipts) that is not worth at least the price of the book to the person desiring to apply it. A great number of them are original contributions prepared expressly for the Encyclopedia, or are to be found only in rare and costly works. *The Scientific American* says: "It is worthy of a place in the library of any home, work-shop, factory or laboratory." Prominent among the immense mass of subjects treated of in the book are the following:

The Art of Dyeing.
Hard, Soft and Toilet Soaps.
Tanning.
Distillation.
Imitation Liquors.
Wines, Cordials and Bitters.
Cider.
Brewing.
Perfumery.
Cologne Water and Perfumed Spirits.
Flavoring Essences, etc.
Cosmetics.
Hair Dyes and Washes.
Pomades and Perfumed Oils.
Tooth Powders, etc.
Syrups.
Alcohol and Alcoholmetry.
Petroleum and Kerosene.
Bleaching and Cleaning.
Scouring and Cleansing.
Vinegar.
Sauces, Catsups and Pickles.
Receipts for the Garden.
To Remove Stains, Spots, etc.
The Extermination of Vermin.
Pyrotechny and Explosives.
Cements, etc.
Soluble Glass.
Waterproofing.
Artificial Gems.
Inks and Writing Fluids.
Aniline Colors.
Liquid Colors.
Paints and Pigments.
Drying Oils and Dryers.
Tests and Re-agents.
Painting and Paper-hanging.
Kalsomine and Whitewash.
Oil and Spirit Varnishes.
Varnishing and Polishing.
Lubricators.
Japanning and Lacquering.
Boot and Harness Blacking.
Photography.
Metals and Alloys.
Soldering and Welding.
Amalgams.
Gilding, Silvering, etc.
Electrotyping, Electroplating, etc.
Medicinal Preparations.
Patent Medicines, etc.
Medical Receipts.
Weights and Measures.
The Metrical System.

The extent of this compilation, the care with which it has been edited and published, and the simple but thorough system of arrangement and index by which its contents are made available for use in practice, combine to render it a highly valuable book. We have examined it; the description and formulæ which it contains appear to be accurate and judiciously selected. The list of authorities quoted and consulted by Mr. Dick comprises the most eminent scientific periodicals of Europe and America, and goes far to guarantee the scientific value of his receipts. For the household, it is calculated to be a precious *vade mecum;* while the practitioner in any industrial art will find much in its pages of especial interest to him.—PROF. ROSSITER W. RAYMOND, in the *Engineering and Mining Journal.*

This work is one of the most valuable ever issued from the press. It embraces an immense variety of chemical and mechanical processes, the explanation of which is aided by a large number of engravings.—*Leffel's Illustrated Mechanical News.*

Mr. William B. Dick has been at the great pains of compiling, and Messrs. Dick and Fitzgerald have had the business enterprise to publish, an octavo of six hundred pages, entitled an "ENCYCLOPEDIA OF PRACTICAL RECEIPTS AND PROCESSES." It would be difficult to say what is not contained in this compilation in the way of domestic industry and household economy. We should think it might be almost invaluable as a companion, guide, philosopher, friend, and physician to the country gentleman. There is hardly an exigency in the daily routine of the family that we can imagine, in which it would not prove useful in its suggestions.—*New York Evening Post.*

In looking through the book one is amazed at the industry and investigation of the compiler. No department of science and art has escaped the vigilance of of this universal "receipter." If you are an honest man you can find in this ENCYCLOPEDIA what an honest man desires to know; if you are a scoundrel, all the methods of counterfeiting and adulterating are ingenuously exhibited.—*Boston Globe.*

607 Pages, Royal Octavo, Cloth. Price.....$5 00
Sheep.....6 00

ELECTRICAL BOOKS.

☞ Copies of any of the following books will be mailed to any address upon receipt of the price. Address

W. J. JOHNSTON, Publisher,

No. 9 Murray Street, New York.

TELEPHONY.

PRACTICAL INFORMATION FOR TELEPHONISTS. By T. D. LOCKWOOD, Electrician, American Bell Telephone Company. 12mo, cloth. New York, 1882. $1.00.

CONTENTS.

Historical Sketch of Electricity from 600 B. C. to 1882 A. D.—Facts and Figures about the Speaking Telephone—How to Build a Short Telegraph or Telephone Line—The Earth and its Relation to Telephonic Systems of Communication—The Magneto Telephone; What it is, How it is made, and How it should be handled—The Blake Transmitter—Disturbances Experienced on Telephone Lines—The Telephone Switch-Board—A Chronological Sketch of the Magneto-Bell, and How to Become Acquainted with it—Telephone Transmitter Batteries—Lightning; its Action upon Telephone Apparatus; How to prevent or reduce Troubles Arising therefrom—The Telephone Inspector—The Telephone Inspector; his Daily Work—The Inspector on Detective Duty—The Daily Routine of the Telephone Inspector—Individual Calls for Telephone Lines—Telephone Wires *versus* Electric Light Wires—Electric Bell Construction—Housetop Lines, Pole Lines and Aërial Cables—Anticipations of Great Discoveries and Inventions.

The chapters of which this book is composed were originally published in THE OPERATOR, where they were found so useful to practical telephone men as to induce an imperative demand for their re-publication in the present convenient form. The book, while giving a mass of valuable information, such as could only be acquired by an extended practical experience with the telephone, is written in an easy, chatty style, which makes it entertaining reading. It is the only book that contains a description of the Blake transmitter, now used almost universally throughout the United States. No one who has anything to do with telephones can fail to find in it something of interest or value; but it is particularly useful to the managers and employés of telephone exchanges, as it gives them valuable instruction about every detail of their work.

THE TELEPHONE. An Account of the Phenomena of Electricity, Magnetism and Sound, as Involved in its Action; with Directions for Making a Speaking Telephone. By A. E. DOLBEAR. Second Edition. 18mo, cloth, 17 illustrations. Boston, 1883. 50c.

CONTENTS.

Electricity—Magnets—The Galvanic Battery—Other Means for Generating Electricity—What is Electricity?—Sound—Correlation—Reiss, Gray, Bell and Dolbear Telephones—How to Make a Telephone.

A very interesting little volume, which clearly explains the fundamental principles of the telephone in an able manner. The first edition had a large sale, and the demand for the book still continuing, a second edition has just been issued at a reduced price.

THE TELEPHONE. A Lecture by PROF. ALEXANDER GRAHAM BELL, Delivered before the Society of Telegraph Engineers. 8vo, paper, 30 illustrations. London, 1870. 60c.

This is a complete and concise account of the stages of experimentation gone through by Professor A. Graham Bell, before his researches resulted in one of the greatest triumphs of modern science. All who believe Bell to be the original inventor of the speaking telephone should have a copy of the work from which to quote. All who believe that he was not, should have one, so as to acquaint themselves with what can be advanced in support of the claims made for Bell. In fact, everybody interested in telephony should read it.

THE TELEPHONE, THE MICROPHONE, AND THE PHONOGRAPH. By COUNT DU MONCEL. Authorized Translation, with Additions and Corrections by the Author. 12mo, cloth, 70 illustrations. $1.25.

CONTENTS.

History of the Telephone—Musical Telephones—Speaking Telephones—Fundamental Principles of Bell Telephone—Battery Telephones—Modification of Bell Telephones—Experiments with the Telephone—Other Experiments with the Telephone—The Microphone—Applications of the Microphone—External Influence on Telephonic Transmissions—Establishment of Telephone Station—Call-Bells and Alarums—Applications of the Telephone—Various Uses of the Telephone—The Phonograph—Uses of the Phonograph—Faber's Speaking Machine—Appendix.

Count Du Moncel's is one of the cheapest books in the market. In his accustomed easy and popular style the author discusses the speaking telephone. Beginning with the Reiss telephone, and giving due place to the musical telephones of Wray, Pollard and Garnier and Varley, and the well-known string telephone, or lovers' telegraph, the magneto telephone of Bell is reached and fully described. After this the respective claims of Gray and Bell are impartially canvassed. The Bell telephone, with its thousand and one modifications, the battery telephone and microphone, with the adaptations of both to oral communication, pass before the reader in turn. A chapter is devoted to disturbances which appear on telephone wires, and another to the phonograph. Those who can only afford one book on the telephone, should make a point of securing this one.

THE SPEAKING TELEPHONE, ELECTRIC LIGHT, AND OTHER RECENT ELECTRICAL INVENTIONS. By GEORGE B. PRESCOTT. 8vo, cloth, 319 illustrations and 1 plate. New York, 1879. $4.00.

CONTENTS.

The Speaking Telephone—Bell's Telephonic Researches—The Telephone Abroad—History of the Production of Galvanic Music—Gray's Telephonic Researches—Edison's Telephonic Researches—Electro-Harmonic Telegraphy—Dolbear's Telephonic Researches—Improvements of Channing, Blake and others—The Talking Phonograph—Quadruplex Telegraphy—Electric Call Bells—The Electric Light—Edison's Recent Telephonic and Acoustic Inventions—Duplex Telegraphs, Electro-Magnets and Electric Time Service.

This is a large and handsome work, the object of which is to furnish the public with a clear and accurate description of the more recent and useful improvements in electrical science, and especially to explain the principles of that marvelous production, the speaking telephone. The most interesting portion of the work, to most readers, is the history of the original telephonic researches of Bell, Gray and Edison, the account of each inventor's experiments being given in his own words. It contains also a very thorough description and explanation of the quadruplex telegraph, with numerous diagrams, showing how the wires are arranged, and gives excellent accounts of the Brush, Maxim, Jablochkoff, Thomson-Houston, and other systems of electric arc lighting, with descriptions of the dynamos, etc. The illustrations throughout the work are very fine.

ELECTRIC LIGHTING.

ELECTRIC LIGHT, ITS PRODUCTION AND ITS USE; EMBODYING PLAIN DIRECTIONS FOR THE WORKING OF GALVANIC BATTERIES, ELECTRIC LAMPS AND DYNAMO-ELECTRIC MACHINES. By J. W. URQUHART, C.E. Edited by F. C. WEBB, M.I.C.E., etc. 8vo, cloth, 94 illustrations. London, 1880. $3.00.

CONTENTS.

Introduction—Voltaic Batteries—Thermo-Electric Batteries—Magneto-Electric Generators—Electro-Magnetic Electric Machines—Dynamo-Electric Machines—General Observations on Machines—Electric Lamps and Candles—Measurement of Electric Light—Mathematical and Experimental Treatment of the Subject—Application and Cost of the Electric Light.

A very convenient and complete treatise on the electric light. The principles are defined in a manner devoid of technicalities, so as to render the book very valuable to the beginner. The history of the dynamo-electric machine and its development, from the Pixii to the Gramme machine, is also quite complete. The recent types of machine receive a full share of attention and the various styles of lamps are treated in full.

ELECTRIC LIGHTING. Translated from the French of LE COMTE TH. DU MONCEL, by ROBERT ROUTLEDGE, B.Sc. Crown 8vo, cloth, 76 illustrations. London, 1882. $1.25.

CONTENTS.

General Considerations—Generators of Electric Light—Electric Lamps—Cost of Electric Lighting—Applications of Electric Light—Conclusion—Notes and Appendices.

A translation of the work of this prolific writer on electrical subjects, published at Paris, in 1880, under the title of "L'Eclairage Electrique," to which the translator has added brief accounts of the apparatus connected with electric lighting which have been brought forth since the publication of the original edition, viz., Swan's, Maxim's, Edison's, and Fox-Lane's incandescent lamps, and the Faure secondary battery. To the student or the general reader who desires information free from abstruse technicalities, and at an insignificant cost, on a subject that is attracting general attention, this work, the original of which is one of a popular science series, can be recommended. The object held constantly in view by the author was to make the treatise thoroughly practical. The book is the cheapest one that aims to cover the whole ground of electric lighting.

ELECTRIC LIGHTING AND ITS PRACTICAL APPLICATION; WITH RESULTS FROM EXISTING EXAMPLES. By J. N. SHOOLBRED. 8vo, cloth, 5 plates. London, 1879. $2.00.

CONTENTS.

Historical and Descriptive—Electric Light Machines—Lamps and Regulators—Carbons; Conducting Wires—Motive Power—Luminous Intensity—Applications; Economic Results—Prospects of Electric Lighting.

A handy little treatise, very valuable to the beginner. The author adopts a popular method of treating the subject and avoids technicalities as much as is compatible with the precision of the work. The history of the early efforts in this field is given, the apparatus being briefly described in each case. The notice of recent inventions, up to the date of print, is quite complete. The questions of power and of photometry form the subjects of very interesting and instructive details.

USEFUL INFORMATION ON ELECTRIC LIGHTING. By KILLINGWORTH HEDGES, M.S.T.E. Fourth Edition, Revised and Enlarged. Crown 8vo, cloth, 20 plates. London, 1883. $1.75.

CONTENTS.

Production of Electricity—Voltaic Arc—Division of the Electric Light—Machines or Generators—Power required, and Motors—Application of the Electric Light—Choice of a System—Setting to Work—Cost of Working—Measurement of Light and Current—Storage of Electricity and Transmission of Power—Electrical Measurement of Work—Useful Memoranda.

The first edition of this work met with so great a success as to encourage the issue of enlarged second and third editions, which have in turn been exhausted. A fourth edition, still further enlarged, has just been issued.

ELECTRIC LIGHTING BY INCANDESCENCE, AND ITS APPLICATION TO INTERIOR ILLUMINATION. A Practical Treatise. By WILLIAM E. SAWYER. 8vo, cloth, 96 illustrations. New York, 1881. $2.50.

CONTENTS.

Introduction—Generators of Electricity—Generators of the Gramme Type—Generators of the new Siemens Type—Incandescent Lamps—Carbons for Incandescent Lighting—New Forms of Lamps—Preservation of Incandescent Carbons—Division of Current and Light—Regulators and Switches—General Distribution—Commercial Aspects.

This book is an indispensable addition to the libraries of all who desire to keep up to the age in the novelty of electric lighting. Its author neglects the arc light altogether, and gives his readers a graphic account of the generators employed in the production of the necessary currents; of those lamps which utilize the currents when generated; of the most advantageous circuit arrangements and apparatus, and of the best materials to use in lighting by incandescence. A historical sketch shows that the idea of electric lighting by incandescence is as old almost as telegraphy itself. The book is handsomely printed and copiously illustrated.

INCANDESCENT ELECTRIC LIGHTS, WITH PARTICULAR REFERENCE TO THE EDISON LAMPS AT THE PARIS EXHIBITION. To which is added The Economy of the Electric Light by Incandescence, by JOHN W. HOWELL; and On the Steadiness of the Electric Current, by C. W. SIEMENS. Illustrated. 18mo, boards. New York, 1882. 50c.

There is no book that contains more valuable information in the same space than this On the question of incandescent lights it must be considered the best authority at present accessible. The tables and data given help very much in analyzing facts and making comparisons. The article by Mr. C. W. Siemens is especially valuable and interesting. It refers to a new method of exciting the field of dynamo-electric machines, which enables the current to maintain itself constant in the external circuit, no matter how great and rapid the variations of resistance may be. This method has come into use as a most valuable adjunct in the dynamos intended for incandescent lamps, where it enables any of the lamps to be put on and off at will without affecting the rest. For this reason this article is of great interest to every person interested in electric lighting.

VARIOUS APPLICATIONS.

ELECTRO-MOTORS. A Treatise on the Means and Apparatus employed in the Transmission of Electrical Energy and its conversion into Motive Power. By J. W. URQUHART. 12mo, cloth, illustrated. London, 1882. $3.00.

CONTENTS.

Introduction—On the Dynamical Nature of Electric Currents—Electrical Measurements—Electro-Magnetic Force—Electro-Magnets and Armatures—Electric Accumulators or Magazines—The Construction and Efficiency of Electro-Motive Machines—Electric Railways—Minor Applications of Electro-Motive Energy—Fragmentary Information.

Undoubtedly the best motors are to be studied from the best generators, since it has been proved that they are mutually reversible; but there are many cases where a motor of a special form and kind is required in order to adapt it to special circumstances and conditions. From this point of view Mr. Urquhart's book fills a void, being the only book on the subject. It contains much interesting and useful information regarding the use of electro-motors industrially, and makes a desirable little book.

ELECTRIC TRANSMISSION OF POWER; ITS PRESENT POSITION AND ADVANTAGES. By PAGET HIGGS, LL.D., D.Sc. Crown 8vo, cloth, 21 illustrations. London, 1879. $1.20

CONTENTS.

Dynamo-Electric Machines—The Gramme Machine—The Brush Machine—The Wallace-Farmer and Siemens' Machines—Efficiency of Dynamo-Electric Machines—Practicability of Transmission of Power by Electricity—Efficiency of Coupled Machines—Comparative Efficiency of Various Machines—Other Theoretical Considerations—Conclusions.

Treats of a new and growing application of electricity, and one destined to become of great industrial importance. The writer discusses impartially the efficiency of the various dynamos for the transmission of power, having no system of his own to advocate.

BOOKS ON SEPARATE BRANCHES OF ELECTRICITY.

ELEMENTARY TREATISE ON ELECTRIC BATTERIES. From the French of ALFRED NIAUDET. Translated by L. M. FISHBACK, of the Bell Telephone Company of Missouri. Second Edition. 12mo, cloth, 55 illustrations. New York, 1882. $2.50.

CONTENTS.

I.—Single-Liquid Batteries—Description of Volta's Battery and its Derivatives—General Remarks upon Batteries—Sulphuric Acid Batteries—Acid Batteries Analogous to that of Volta—Batteries without Acids—Other Batteries. II.—Two-Liquid Batteries—The Daniell Battery—Gravity Batteries—General Remarks upon Daniell Batteries—Batteries Derived from the Daniell—Acid Batteries—Oxides in Batteries—Chloride Batteries—Depolarizing Mixture Batteries. III.—Various Batteries—Tables.

Mr. George d'Infreville, one of the electricians of the Western Union Telegraph Company, writes: "This work will serve to guide the uninitiated in the choice and management of batteries, and even the professional electrician may find, not only new matter, but even old material, presented in a new form and worked to new developments. Telegraphers generally will find many of their frequently recurring problems solved in its pages, and its perspicuity will save both inventor and investigator from making useless experiments or errors, while at the same time the work offers to all new fields for careful research. Although the subject treated is so useful and interesting, yet this is, I believe, the first time it has received such recognition in English as its importance demands."

FOUR LECTURES ON STATIC ELECTRIC INDUCTION. By J. E. H. GORDON, B. A. 18mo, cloth, 39 illustrations. New York, 1881. 80c.

CONTENTS.

Introductory—Preliminary Experiments—Induction a State of Strain—How the Electric Strain is Propagated—Faraday's Experiments—Specific Inductive Capacities of Different Media—The Electro-Magnetic Theory of Light—Actions of Electricity on Light and *Vice Versa*.

Electro-static induction is a most important factor in underground and cable telegraphy and in telephony, and some knowledge of it is an essential preliminary to the study of the action of dynamo-electric machines. This little volume tells what it is and how it acts, and elucidates some of the most profound of modern electrical theories, in language that any one can understand.

INDUCTION COILS. HOW MADE AND HOW USED. DYER. Reprinted from the Eighth English Edition. 16mo, boards, 63 illustrations. New York, 1881. 50c.

CONTENTS.

Current Electricity—Galvanic Batteries—Batteries, How Constructed—Induced Electricity—How a Coil is Made—How an Intensity Coil is Made—How an Intensity Coil is Used—Vacuum Experiments.

This interesting little book may be regarded as a complement of the one last mentioned, the former relating exclusively to electro-static induction, or the inductive effects of electricity at rest, while the latter treats of electro-dynamic induction, or the inductive effects of electricity in motion. The title of the book and the brief table given above convey an imperfect idea of its varied contents. Like the previous work, it is written in simple language. It tells how to make the various forms of the apparatus, and describes a great many beautiful and interesting experiments that may be made by means of it. It is, therefore, just the kind of book the student wants who "means business."

A HAND-BOOK OF THE ELECTRO-MAGNETIC TELEGRAPH. By A. E. LORING. 18mo., 26 illustrations. New York, 1878. Boards, 50c.; cloth, 75c.; morocco, $1.00.

CONTENTS.

Electricity and Magnetism—The Morse Telegraph—Batteries—Practical Telegraphy—Construction of Line—Suggestions and Exercises for Learners.

This is a little book which can be conveniently carried in the pocket by the student. The writer is a practical telegraph operator. In addition to clearly explaining the common Morse telegraphic apparatus, it tells how to proportion instruments and batteries to the lines, and describes the ordinary methods of testing for crosses, grounds, breaks, escapes, etc. It is an excellent book for the beginner.

HANDBOOK OF NATURAL PHILOSOPHY. ELECTRICITY, MAGNETISM AND ACOUSTICS. By DIONYSIUS LARDNER, D.C.L. Ninth Thousand. Edited by Prof. G. C. FOSTER. 8vo, cloth, 400 illustrations. London, 1874. $2.00.

CONTENTS.

Electrical Attractions and Repulsions—Conduction—Induction—Electrical Machines—Condenser and Electrophorus—Electroscopes—The Leyden Jar—Laws of Electrical Forces—Mechanical Effects of Electricity—Thermal Effects of Electricity—Luminous Effects of Electricity—Chemical and Magnetic Effects of Electricity—Sources of Electricity—Simple Voltaic Combinations—Voltaic Batteries—Voltaic Currents—Reciprocal Influence of Rectilinear Currents and Magnets—Electro-Magnetic Induction—Influence of Terrestrial Magnetism on Voltaic Currents—Reciprocal Influence of Voltaic Currents—Voltaic Theory of Magnetism—Reoscopes and Reometers—Photomagnetism and Diamagnetism——Thermo-Electricity—Electro-Chemistry—Electro-Metallurgy—Electro-Telegraphy—Calorific, Luminous and Physiological Effects of the Voltaic Current—Magnetism; Definitions and Primary Phenomena—Magnetism by Induction—Terrestrial Magnetism—Magnetization—Acoustics—Theory of Undulations—Production and Propagation of Sound, Physical Theory of Music—Vibrations of Rods and Plates—Vibrations of Fluids—The Ear.

Treating of Electricity, Magnetism and Acoustics—the three elements that are united in the telephone—this volume may be appropriately studied as an introduction to the theory of that instrument, though written before the telephone was invented. The work has been so long and so well known, and has had so extensive a circulation, that it deserves to be called a classic among English text-books.

LIGHT AND ELECTRICITY. Notes of two Courses of Lectures before the Royal Institution of Great Britain. By JOHN TYNDALL. 12mo, cloth. New York, 1881. $1.25.

CONTENTS OF THE PORTION RELATING TO ELECTRICITY.

Voltaic Electricity; the Voltaic Battery—Electro-Magnetism; Elementary Phenomena—Electro-Magnetic Engines—Physical Effects of Magnetization—Character of Magnetic Force—Magnetism of Helix; Strength of Electro-Magnets—Electro-Magnetic Attractions; Law of Squares—Inference from Law of Squares; Theoretic Notions—Diamagnetism; Magne-Crystallic Action—Frictional Electricity; Attraction and Repulsion; Conduction and Insulation—Theories of Electricity; Electric Fluids—Electric Induction; the Condenser; the Electrophorus—The Electric Machine; the Leyden Jar—The Electric Current—The Electric Discharge; Thunder and Lightning—Electric Density; Action of Points—Relation of Voltaic to Frictional Electricity—Historic Jottings concerning Conduction and the Leyden Jar—Historic Jottings concerning the Electric Telegraph—Phenomena Observed in Telegraph Cables—Artificial Cables—Sketch of Ohm's Theory and Kohlrausch's Verification—Electro-Chemistry; Chemical Actions in the Voltaic Cell; Origin of the Current—Chemical Actions at a Distance; Electrolysis—Measures of the Electric Current—Electric Polarization; Ritter's Secondary Pile—Faraday's Electrolytic Law—Nobili's Iris Rings—Distribution of Heat in the Circuit—Relation of Heat to Current and to Resistance—Magneto-Electricity; Induced Currents—Relation of Induced Currents to the Lines of Magnetic Force; Rotary Magnetism—The Extra Current—Influence of Time on Intensity of Discharge; the Condenser—Electric Discharge through Rarefied Gases and Vapors—Action of Magnets on the Luminous Discharge—Magneto-Electric Machines; Saxton's Machine; Siemens' Armature; Wilde's Machine; Siemens' and Wheatstone's Machine—Induced Currents of the Leyden Battery.

As we remarked above, in speaking of Prof. Tyndall's "Lessons in Electricity," there is no better expositor of the principles of electrical science. The present volume contains notes of two series of lectures on Light and Electricity, for a more mature audience that to which the former series was addressed.

Electrical Scientific Books.

For Sale by W. J. JOHNSTON, 9 Murray St., New York.

	Style of Binding.	Price, postage prepaid
Abernethy's Commercial and Railway Telegraphy	Cloth.	$2.00
Anderson's Lightning Conductors	Cloth.	6.50
Ayrton's Improvements Science can effect	Paper.	.20
Baile's Wonders of Electricity	Cloth.	1.25
Beechey's Electro Telegraphy	Cloth.	.40
Bell's Lectures on the Telephone	Paper.	.60
Bond's Handbook of the Telegraph	Board.	1.20
Cavendish's Electrical Researches	Cloth.	5.00
Clark and Sabine's Electrical Tables and Formulæ	Cloth.	5.00
Culley's Handbook of Practical Telegraphy	Cloth.	6.00
Cumming's Theory of Electricity	Cloth.	3.00
Davis & Rae's Electrical Diagrams and Connections	Cloth.	2.00
Day's Exercises in Electrical and Magnetic Measurement	Cloth.	1.00
Dolbear's Telephone	Cloth.	.50
Douglas' Telegraph Construction	Cloth.	6.00
Dredge's Electric Illumination	Cloth.	7.50
DuMoncel's Telephone, Microphone and Phonograph	Cloth.	1.25
DuMoncel's Electric Lighting	Cloth.	1.25
DuMoncel's Electro Magnets. American Edition	Boards.	.50
DuMoncel's Electro Magnets. English Edition	Cloth.	.75
Dyer's Induction Coils	Boards.	.50
Electric Lighting Act, 1882	Cloth.	2.00
Faraday's Researches in Electricity. 3 Vols.	Cloth.	20.00
Ferguson's Electricity. New Edition	Cloth.	1.50
Gordon's Lectures on Induction	Cloth.	.80
Gordon's Electricity and Magnetism. 2 Vols.	Cloth.	7.00
Gore's Electro-Metallurgy	Cloth.	2.50
Grierson's Electric Lighting by Water Power	Paper.	.40
Harris' Rudimentary Electricity	Boards.	.60
Harris' Rudimentary Galvanism	Boards.	.60
Harris' Rudimentary Magnetism	Boards.	1.80
Haskins' Galvanometer	Morocco	1.50
Hedges' Useful Information on Electric Lighting	Cloth.	1.75
Higg's Candle Power of the Electric Light	Paper.	.25
Higg's Electric Transmission of Power	Cloth.	1.20
Holmes' Electric Light Popularly Explained	Paper.	.40
Hoskiær's Laying and Repairing of Cables	Cloth.	1.50
Hoskiær's Guide for Testing Telegraph Cables	Cloth.	1.50
Hospitalier's Modern Applications of Electricity	Cloth.	4.50
Incandescent Electric Lights	Boards.	.50
Jenkin's Electricity and Magnetism	Cloth.	1.50
Kempe's Electrical Testing	Cloth.	5.00
Langdon's Application of Electricity to Railway Working	Cloth.	1.50
Lardner's Natural Philosophy, Electricity, Magnetism, & Acoustics	Cloth.	2.00
Larrabee's Cipher, Letter and Telegraph Code	Flexible	1.00
Levander's Solution of Questions in Magnetism and Electricity	Cloth.	1.00
Lockwood's Practical Information for Telephonists	Cloth.	1.00
Loring's Handbook of the Telegraph	Morocco, 1.00; Cloth, 75;	Boards. .50
Maxwell's Electricity and Magnetism. 2 Vols.	Cloth.	8.00
Maxwell's Elementary Treatise on Electricity	Cloth.	2.00
McGregor's Questions on Magnetism and Electricity	Boards.	.60
Napier's Manual of Electro-Metallurgy	Cloth.	3.00
Niaudet's Electric Batteries	Cloth.	2.50
Noad's Students' Text-Book of Electricity	Cloth.	4.00
Parnell's Action of Lightning	Cloth.	3.00
Pope's Modern Practice of the Electric Telegraph	Cloth.	2.00
Preece & Sivewright's Telegraphy	Cloth.	1.50
Prescott's Electricity and the Electric Telegraph	Cloth.	5.00
Prescott's Telephone, Electric Light and other Recent Inventions	Cloth.	4.00
Reports of Committee on Electrical Standards	Cloth.	3.75
Sabine's History and Progress of the Electric Telegraph	Cloth.	1.25
Sawyer's Electric Lighting by Incandescence	Cloth.	2.50
Schwendler's Testing. 2 Vols.	Cloth.	8.00
Shoolbred's Electric Lighting	Cloth.	2.00
Smith's Manual of Telegraphy	Paper.	.30
Spang's Lightning Protection	Cloth.	1.50
Sprague's Electric Lighting	Paper.	.40
Thompson's Elementary Electricity and Magnetism	Cloth.	1.25
Tyndall's Lessons in Electricity	Cloth.	1.00
Tyndall's Light and Electricity	Cloth.	1.25
Urquhart's Electro-Plating	Cloth.	2.00
Urquhart's Electro-Typing	Cloth.	2.00
Urquhart's Electric Light	Cloth.	3.00
Urquhart's Electro-Motors	Cloth.	3.00
Watt's Electro-Metallurgy	Cloth.	1.00
Woodbury's Protection and Construction of Mill Floors	Cloth.	2.50
Wrinkles and Recipes	Cloth.	2.00

Copies of any of the above books, or of any other work relating to the Science of Electricity will be promptly forwarded to any address in the United States, Canada, Newfoundland, Mexico, or any foreign country in the Universal Postal Union, postage prepaid, on receipt of the price.

Remittance can be made by Post Office order, draft, registered letter and express. Address

W. J. JOHNSTON, PUBLISHER,

No. 9 Murray Street, New York.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

FIREPROOF INSULATED ELECTRIC LIGHT WIRE

From Pure Lake Superior Copper. Conductivity Guaranteed.

Patent "K. K." Insulated Copper and Iron Wire, for Telephone and Telegraph Use.

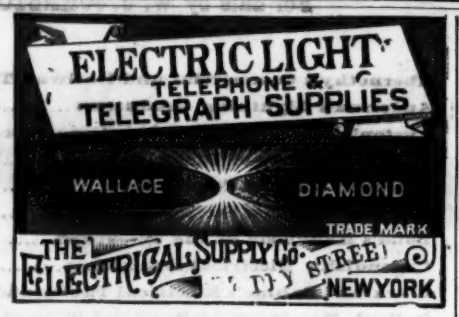
49 CHAMBERS ST., N. Y. WORKS: WATERBURY, CONN. 18 FEDERAL ST., BOSTON.

HAINES BROS.,

Promoters and Brokers

55 BROADWAY, N. Y.

Electrical Stocks a Specialty.



PHOSPHOR-BRONZE TELEPHONE WIRE.

"Phosphor-Bronze."

The STRONGEST, TOUGHEST and BEST for line wires of electric and acoustic telephones. Will not STRETCH nor RUST. RESISTS SMOKE, ACIDS and DAMPNESS. TENACITY more than FOUR times its weight per mile.

PHOSPHOR-BRONZE RODS, SPRING METAL AND WIRE, superior to German silver or brass for electrical apparatus. Already extensively used throughout the country. Address

THE PHOSPHOR-BRONZE SMELTING CO., LIMITED,
512 ARCH ST., PHILADELPHIA, PA.

Owners of the U. S. Phosphor-Bronze Patents. Sole Manufacturers of Phosphor-Bronze in the United States.

Yellow Cedar Telegraph Poles,

Railroad Ties, Paving Timber and Fence Posts for Telegraph, Electric Light, Telephone and Railroad Companies' Use.

The Michael Bay Lumber Co. (Limited) have on hand and cut to order Yellow Cedar Telegraph Poles, which will last from eight to ten years longer than white cedar or chestnut. Yard and office at Buffalo, Black Rock, N. Y. Standard poles, 25 feet, 6 inch top; 30 feet, 6 and 7 inch top, and long poles from 35 to 60 feet in car load lots from Black Rock, and by vessel loads at Lake Erie and Lake Michigan ports on the opening of navigation. Fifty thousand ready to deliver April and May. Correspondence solicited. All orders addressed to

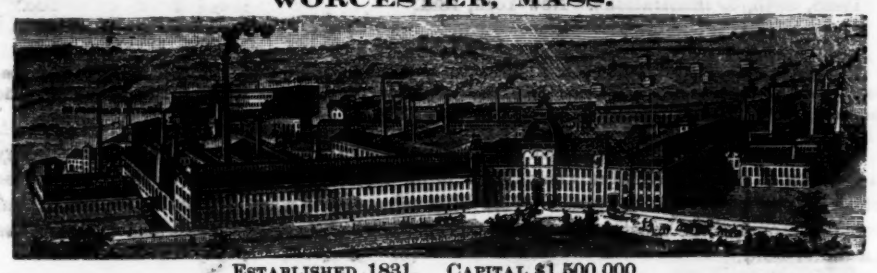
A. A. COLBY, AGENT, BUFFALO, N. Y.,

Post Office Box 297. Will receive prompt attention.

TELEGRAPH WIRE. TELEPHONE WIRE.

WASHBURN & MOEN MANUFACTURING COMPANY.

WORCESTER, MASS.



ESTABLISHED 1831. CAPITAL $1,500,000.

16 Cliff and 241 Pearl Street, New York.
215 Lake Street, Chicago.

This Company having given careful attention to Telegraph Wire from the introduction of the Art of Telegraphy, and especially with reference to the conditions necessary to *highest electric conductivity*, does not hesitate to recommend this class of its products as unequaled in that particular. Being the first to

MAKE A SPECIALTY OF TELEGRAPH WIRE,

and anticipating at an early day the great demand that would exist for that article, they have adopted and fully proved certain methods and appliances for the production of Telegraph as well as of Telephone Wire which are peculiar to themselves. Among them may be mentioned the

PATENT CONTINUOUS ROLLING MILL, PATENT CONTINUOUS GALVANIZING BATH, AND THE BELGIAN ROLLING MILL.

(In connection with the DOUBLE SIEMENS FURNACE).

All Wire made by this Company for Telegraph or Telephone purposes is thoroughly tested before shipping, with regard to Conductivity, Tensile and Torsion strength, as well as Elongation.

Prices and terms for Telegraph or Telephone Wire—Plain, Oiled or Galvanized—given upon application.

N. B.—The qualities known as extra Best (E. B. B.) and Best Best (B. B.) kept constantly in stock.

0000 HOOLE MANUFACTURING CO. 0000

46 Bond St., New York.

HENRY W. GWINNER, *President.* WM. H. WOOLVERTON, *Treasurer.*

This Company is prepared to furnish, at short notice, full lines of LIGHT RAILROAD AND FACTORY SUPPLIES. Communications and orders will receive prompt attention.

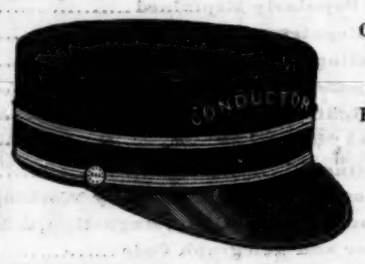
CHECKS.

BAGGAGE CHECKS,
HOTEL CHECKS,
RESTAURANT CHECKS,
LAUNDRY CHECKS,
BARBERS' CHECKS,
POOL CHECKS.

BADGES.

Cap Badges, Breast Badges, Medals and Badges for Societies. Special designs furnished.

CONDUCTORS' PUNCHES.



BRASS TAGS.

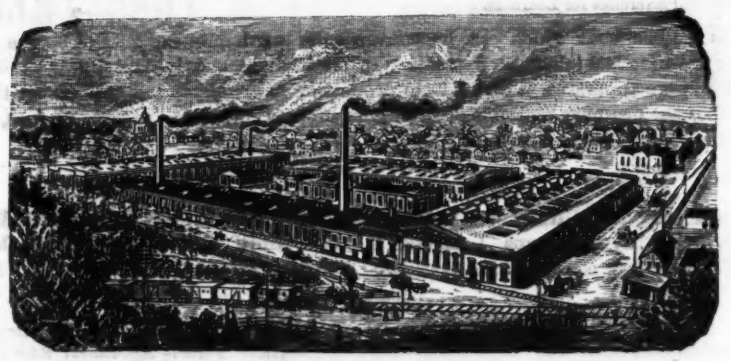
Consecutively numbered and punched at end, or both ends, for use of Laundries.

UNIFORMS.

For Employés. Caps of every form, Canvas Caps, Cloth Caps, Sailor and Yachting Caps, Hats, Helmets, Sailor Suits, Jerseys, Buttons, with name of organization, monogram, or special designs.

HAND STAMPS.

ARC LIGHTS.



WE DESIRE TO CALL ATTENTION TO THE

BRUSH MACHINES

We are now manufacturing, intended to give lights of about two-thirds of the power of our usual size of arc lights. They are fully equal to the ordinary size lights of other systems, and except in the amount of light are the same in every respect as our other lights.

Number of Machine.	Number of Arc Lights.	Nominal Candle Power.	Horse-Power required.
5	10	1,200	6
6	20	1,200	11
7	30	1,200	15
8	64	1,200	35

Prices of our machines and lamps the same as our regular list. Our agents will give estimates. We shall commence this month the shipment of

BRUSH STORAGE BATTERIES

To fill the large orders which have accumulated on our books. We desire to state that these batteries are

GUARANTEED

By this Company, just as all the apparatus hitherto sold by us has been; and that the statements of our opponents regarding them, which have been so industriously circulated of late, are false in every particular.

THE BRUSH ELECTRIC CO.,

No. 379 Euclid Avenue,

CLEVELAND - - OHIO.

MAY 12, 1883.

GEORGE WESTINGHOUSE, Jr., President. ROBERT PITCAIRN, Treasurer.
C. H. JACKSON, Vice President and General Manager. ASAPH T. ROWAND, Secretary.
HENRY SNYDER, General Agent.

THE UNION SWITCH AND SIGNAL CO.,

PITTSBURGH, PENNA.,

A CONSOLIDATION OF

THE UNION ELECTRIC SIGNAL CO., AND OF THE INTERLOCKING SWITCH & SIGNAL CO.

Of Boston, Mass. Of Harrisburg, Pa.

SOLE OWNERS AND MANUFACTURERS OF THE ONLY PRACTICALLY SUCCESSFUL SYSTEM OF

OPERATING RAILROAD SIGNALS AUTOMATICALLY.

ALSO OF

APPARATUS FOR OPERATING AND INTERLOCKING SWITCHES, SIGNALS AND GATES BY LEVERS, HYDRAULICS, PNEUMATICS OR ELECTRICITY.

ALSO MANUFACTURERS OF

FROGS, CROSSINGS, SWITCHES AND SWITCH STANDS.

☞ Plans, estimates and detailed descriptions, together with references to apparatus in practical operation, will be furnished upon application.

Office and Works, Corner Fayette Street, Garrison Alley and Duquesne Way.

Iron Telegraph & Telephone Wire,

MANUFACTURED BY

Fred'k Smith & Co.,

HALIFAX, - ENGLAND.

Wire Delivered on Board in Liverpool for Shipment to any Part of the World,

OR FROM STOCK IN NEW YORK,

Or in Bond, or Duty Paid in any Part of the United States.

Full particulars, quotations in sterling or currency, and tables and samples on application.

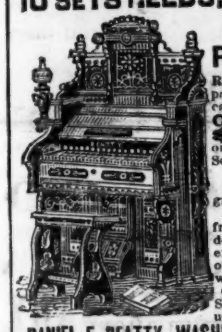
THE ELECTRICAL SUPPLY CO.,

Sole Agents for the United States,

17 Dey St., N. Y.

BEATTY

27 STOPS 10 SETS REEDS. BEETHOVEN ORGANS.

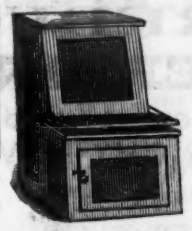


Price only $125

Really worth $450 if compared with other makers' catalogue prices. $85 Organs for only $59. Special bargains on Organs and Pianofortes. Send for midsummer price & CATALOGUE great inducements offered. VISITORS WELCOME free coach meets trains, five dollars allowed for traveling expenses, whether you buy or not you are welcome anyway to visit the largest Organ Works in existence. Shipping one every 10 minutes. Address or call upon

DANIEL F. BEATTY, WASHINGTON, NEW JERSEY.

T. G. SELLEW,
MANUFACTURER OF
DESKS,
OFFICE AND LIBRARY FURNITURE,
No. 111 Fulton St., New York.
FINE CYLINDER AND ROLL DESKS.
Offices fitted up with Counters and Partitions.



WAKEFIELD
EARTH CLOSET.
JOS. J. WALTON,
23 & 25 Dey St., N. Y.

TELEPHONE SERVICE
Without Induction and with Clear Articulation.
Nos. 14 and 12 Spiral Wire for long and short lines.
American Spiral Telephone Wire Co.,
43 Milk St., Boston, Mass., U. S.

THE KERNER STYLOGRAPHIC PEN.

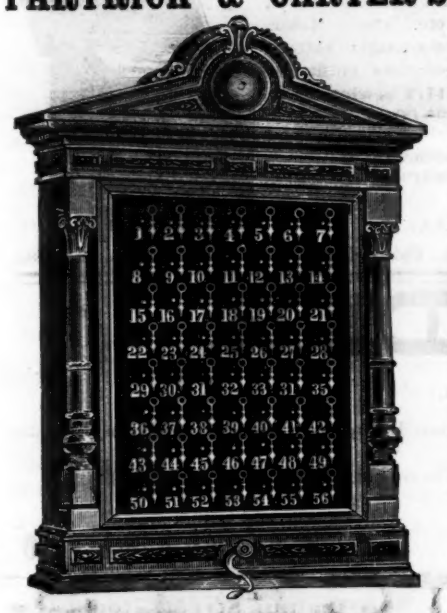
$1.00. $1.00.

THEBESTESTPENFORTHELEASTESTMONEY.
THE LATEST IMPROVEMENT IN STYLOGRAPHIC PENS.

The flexible air tube attached to the needle extension gives a soft and delicate touch to the pen and a vibratory motion which keeps the ink in a constant state of agitation while writing and causing a perfect flow to the point. Our $1.00 pen equal to the best. The difference in price depends alone upon the ornamentation. **Our No. 5 RULING PEN is the BEST IN THE WORLD for Book-keepers.** A perfect line always assured. No blurring or blotting. Price $1.50. Other styles according to mounting, $1.25, $1.50 and $3.00. Ask your stationer for them, or send to

THE KERNER STYLOGRAPHIC PEN COMPANY, 25 Bond Street, New York.
☞ Beware of imitations. Ask for "THE KERNER."

PARTRICK & CARTER'S



ELECTRIC ANNUNCIATOR.

(Patented Feb. 16, 1875.)

We guarantee our Annunciator to be the most **Simple**, Durable and Reliable Apparatus in the market. **No Drops** or other **Complicated Mechanism** to get out of order and **necessitating constant repairs.** We have furnished some of the largest and finest hotels in the country with our Annunciators.

Those wishing **Agencies** for these Annunciators in unlicensed territory can obtain all information, prices, etc., by addressing us.

Correspondence solicited with all **Operators, Managers of Telephone Exchanges** and **Electric Bell-hangers.** Send for **Catalogue of Annunciators, Alarms, Electric Bells, etc.**

PARTRICK & CARTER,
114 South Second St., Philadelphia, Pa.

Just Published!
ELECTRIC ILLUMINATION
Quarto, 906 Pages, 833 Illustrations.
Cloth. Price $7.50.
Address,
W. J. JOHNSTON, Publisher,
No. 9 Murray St., New York.

TELEGRAPH AND TELEPHONE POLES.

65,000 25 to 60 feet, No. 1 Quality.

These Poles are Live Timber, well seasoned, and in every way desirable. Deliverable on line of F. & P. M., Mack. Div. M. C., P. O. & Pt. Austin Railroads.

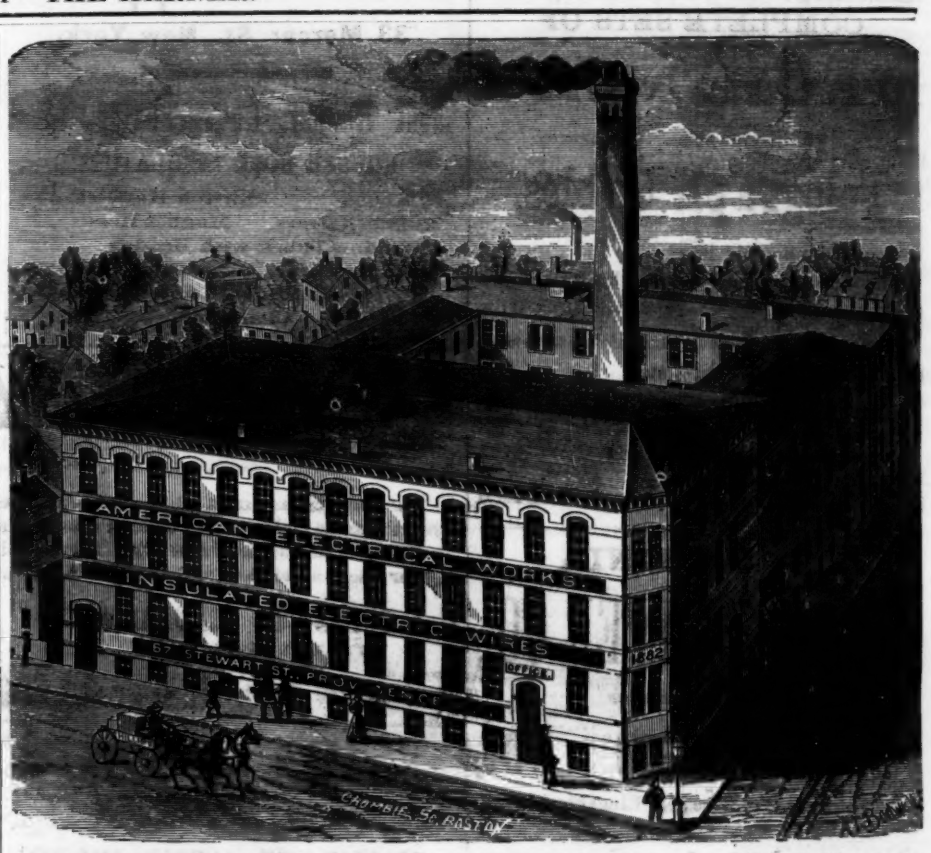
Electric Light, Railroad, Telegraph and Telephone Companies supplied. Prompt delivery.

HENRY C. RIPLEY,
EAST SAGINAW, MICH

J. H. LONGSTREET,

No. 9 Barclay Street,
NEW YORK,
MANUFACTURER AND DEALER IN
TELEGRAPH INSTRUMENTS,
Telephone and Telegraph Supplies
OF EVERY DESCRIPTION,
ANNUNCIATORS AND BURGLAR ALARM APPARATUS, BATTERIES AND BATTERY MATERIAL.

Telegraph Instruments for Railroad Use a Specialty.



AMERICAN ELECTRICAL WORKS

(Formerly EUGENE F. PHILLIPS),
MANUFACTURERS OF
PATENT FINISHED
INSULATED ELECTRIC WIRES,
TELEPHONE AND ELECTRIC CORDAGE,
ELECTRIC LIGHT WIRE.

Magnet Wire, Patent Rubber-Covered Wire, Burglar Alarm and Annunciator Wire, Lead-Encased Wire; Anti-Induction Aerial and Underground Cables, etc., etc.

Office and Factory, 67 Stewart Street, Providence, R. I.
EUGENE F. PHILLIPS, President. W. H. SAWYER, Secretary and Electrician.

MAGNETO AND BATTERY SIGNAL BELLS.

We have a large number of second-hand Magneto Bells, without the Telephone switch or connections, for sale at extremely low prices.

These bells are admirably *adapted for Stable, Hotel, Restaurant* and many other purposes where a call bell of any sort would be of service for signaling or summoning all kinds of employés, servants, etc.

They will ring on any length of line and give a clear and distinct sound. THE GREAT ADVANTAGE in using such an instrument is, *YOU CAN SIGNAL BACK.*

NO BATTERY IS REQUIRED.

No Skill Necessary to Set up or Operate Them, and Always Reliable.

PRICE, $4 EACH. DISCOUNT ON LARGE LOTS.

We have a lot of these very handsome altered Telephon Bells, and will sell them at less than cost of manufacture.

They are wound to 30 ohms resistance; silk-covered wire nickel-plated bell, 3½ inches diameter, and working parts covered with nickel-plate case.

Price, vibratory..... $1.75 each.
" single stroke..... 1.60 "

WORTH TWO ORDINARY BOX BELLS AT TWICE THE PRICE.

DAVIS & WATTS, Baltimore, Md.,

Manufacturers and Dealers in all kinds of
ELECTRICAL AND TELEPHONE INSTRUMENTS AND SUPPLIES,
QUOTATIONS PROMPTLY AND CHEERFULLY FURNISHED.

ASTONISHING REDUCTION IN PRICES!!
WE ARE DETERMINED TO SELL GOODS.

Don't order until you have sent for our new reduced list. By seeing and comparing our prices you will be convinced that we mean business. NOW, RIGHT NOW, while you think of it, is the time to write us for prices.

C. E. JONES & BROTHER,
MANUFACTURERS AND DEALERS IN
TELEGRAPH AND ELECTRICAL SUPPLIES,
CINCINNATI, OHIO.

TELEPHONES!
For private lines. Latest, best; always reliable; work 2 miles on cable-wire. Illus. Circulars free. Holcomb & Co., Cleveland, O.

ELECTRO-MAGNETS.

ELEMENTS OF CONSTRUCTION, with numerous formulas and examples, showing the best methods of construction and grouping of cells. 8vo, cloth, 75 cents. Postage prepaid.
E. & F. N. SPON, 35 Murray St., N. Y.

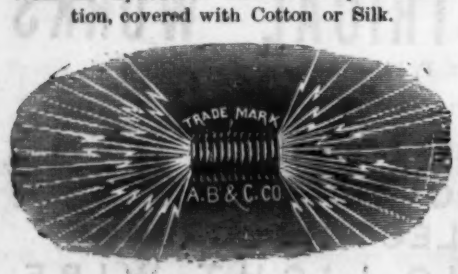
COMPLETE SETS OF
MACHINERY
FOR THE MANUFACTURE OF
Telegraph Cables.

Wire Stranding Machines.
Complete sets of machinery for Purifying India Rubber and Gutta Percha, and Insulating Wire.
Lapping Machines for covering Wire with Silk, Cotton, Flax, Hemp, Tape, etc.

Thomas Barraclough & Co., Limited,
8 KING STREET,
Manchester, - - - England

THE ANSONIA
BRASS & COPPER CO.,
MANUFACTURERS OF
Pure Electric Copper Wire,
For Magnets, Telephones, Electric Lights, &c.

With H. Splitdorf's Patented Liquid Insulation, covered with Cotton or Silk.



LINE WIRE.
FIREPROOF HOUSE AND OFFICE WIRE FOR IN-DOOR USE IN ELECTRIC LIGHTING.
Wrought Metal Gongs, for Annunciators, Telephones, &c.
ZINC RODS, BATTERY COPPER, &c.
No. 19 and 21 Cliff St., NEW YORK

SHORTHAND AT YOUR HOMES.
COMPLETE INSTRUCTION in highest grade $20, and satisfaction assured in every respect. Send 10 cts. for specimens and terms,
R. B. CLARKE, Stenographer,
4937 Germantown Ave., Philadelphia, Pa.

THE BUTLER HARD RUBBER CO.
Electrical Supplies,
33 Mercer St., New York.
Manufacturers of
Sheet Rubber, Rods, Tubing, Etc.,
RUBBER HOOK INSULATORS.
Key Knobs, Switch Handles,
Magnet Covers, Magnet Heads,
Window Tubes, with Heads,
Battery Cells, Battery Syringes,
And Specialties of any Required Character.

ESTABLISHED 1859.
PLATINUM.
H. M. RAYNOR,
25 BOND STREET, New York.

BOSTON AND SANDWICH
GLASS CO.
OFFICE AND SAMPLE ROOMS,
No. 17 MURRAY ST., N. Y.
REPRESENTED BY
C. E. L. BRINKERHOFF.

SEWING-MACHINE ATTACHMENT.

THE Double Induction ELECTRIC MOTOR
For FAMILY sewing-machines; dental, jewelers' and watchmakers' lathes, fans, etc., etc. Motor, with automatic battery and complete outfit for FAMILY sewing-machines, $35.00 to $40.00.
Double Induction Motors, Dynamo Machines, Automatic Batteries, Experimental Apparatus, etc. In writing for illustrated catalogue, give street and number.
THE ELECTRO DYNAMIC CO.,
19 E. 15th St., New York. 121 South Third St., Philadelphia.

THE AUTOMATIC BATTERY

Canton St., London, Eng.

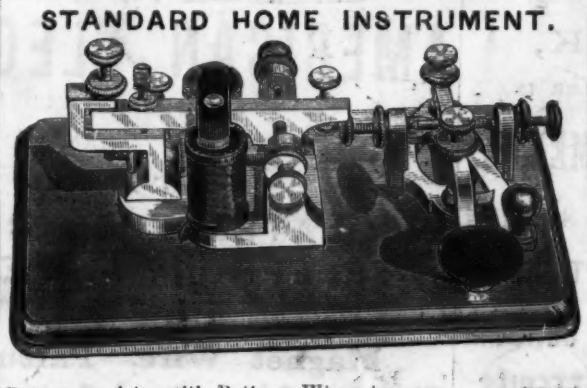
ATLAS POWDER.
(A NITRO-GLYCERINE COMPOUND.)

The strongest and most reliable of the many compounds generally termed high explosives, and conceded by every one of experience to be the *safest* to handle and transport under all conditions.
Put up in cartridges of nine different grades, and of various diameters and lengths, and packed in boxes holding 50 pounds and 25 pounds.
For sale in all sections of the country by the authorized Agents of

E. I. DUPONT DE NEMOURS & CO, WILMINGTON, DEL.
LAFLIN & RAND POWDER CO., NEW YORK.
HAZARD POWDER CO, NEW YORK.

Manufactured by the **REPAUNO CHEMICAL CO.,** 305 Walnut Street, Room G, P. O. Box 2,472, PHILADELPHIA.

STANDARD ELECTRICAL WORKS,
CINCINNATI, OHIO.

STANDARD HOME INSTRUMENT.


Price, complete, with Battery, Wire, etc	$3.50
Instrument only	2.80
Instrument wound with fine wire	3.50
Instrument, all Brass	5.00
Instrument, " Nickel Plated	6.00

Galvanized Telegraph Wire, all numbers and grades.
Brackets and Pins.
Insulators, Glass and Porcelain.
Cross Arms.
Office Wire.
Annunciator Wire.
Pole Rings.
Pole Steps.
Leclanche Batteries.
Gravity Batteries.
Office Fixtures.
Tools, Etc., Etc.

Stevens Patent Top Contact Key.
Price, $4.00 each, - - Post-paid.

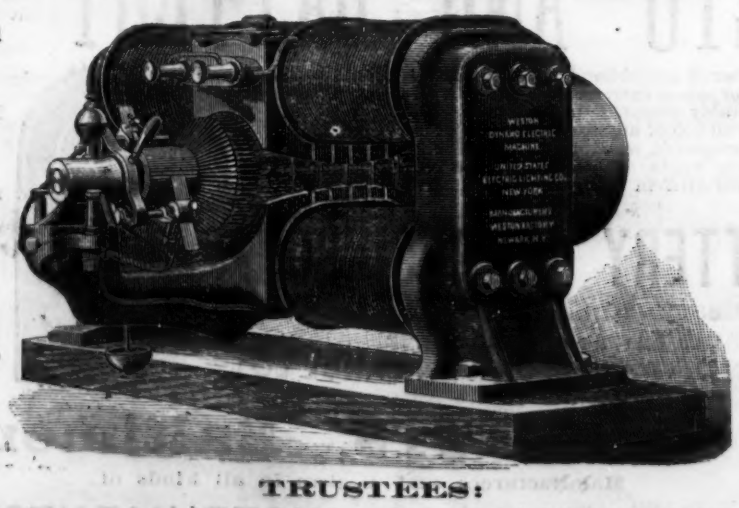
Top Contact, Top Connection, Non-Sticking Easy Working, Thoroughly Tested and Universally approved.

Standard Telegraph Key	$2.75
Bunnell Steel Lever "	3.00
Legless Rubber Base "	2.25
Giant Sounder	3.50
Pony Sounder	3.00

SEND FOR ILLUSTRATED CATALOGUE.

THE UNITED STATES ELECTRIC LIGHTING COMPANY,
59 and 61 Liberty Street, New York.
Complete Systems of Arc and Incandescent Electric Lighting Apparatus.

This Apparatus Combines the Highest Electrical Efficiency with the best Mechanical Design, and is unequaled for
ECONOMY, SAFETY,
SIMPLICITY
AND THE
QUALITY OF LIGHT PRODUCED.



DYNAMO MACHINES,
ELECTRIC MOTORS,
ARC LAMPS,
INCANDESCENT LAMPS,
STORAGE BATTERIES,
CARBONS, Etc., Etc.

Estimates Furnished on Application.
GEO. W. HEBARD, President.
Send for Illustrated Catalogue.
L. E. CURTIS, Secretary.

TRUSTEES:
M. HARTLEY, A. P. STOKES, CHAS. R. FLINT, R. B. MINTURN, G. W. HEBARD, H. B. HYDE, L. FITZGERALD, W. T. HATCH, J. H. HUBBARD, T. A. STEWART, HENRY DAY, L. E. CURTIS.